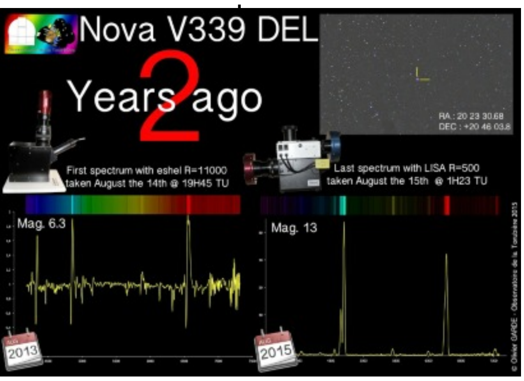
Eruptive stars spectroscopy
Cataclysmics, Symbiotics, Novae, Supernovae

ARAS Eruptive Stars
Information letter n° 18 #2015-06 06-09-2015
Observations of July-August 2015



Olivier Garde : 2 years of observations of Nova Del 2013

1151 spectra in aras data base (asdb)
asdb Nova Del 2013

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ARAS Spectroscopy

ARAS Web page
http://www.astrosurf.com/aras/

ARAS Forum
http://www.spectro-aras.com/forum/

ARAS list
https://groups.yahoo.com/neo/groups/spectro-l/info

ARAS preliminary data base
http://www.astrosurf.com/aras/Aras_DataBase/DataBase.htm

ARAS BeAM
http://arasbeam.free.fr/?lang=en

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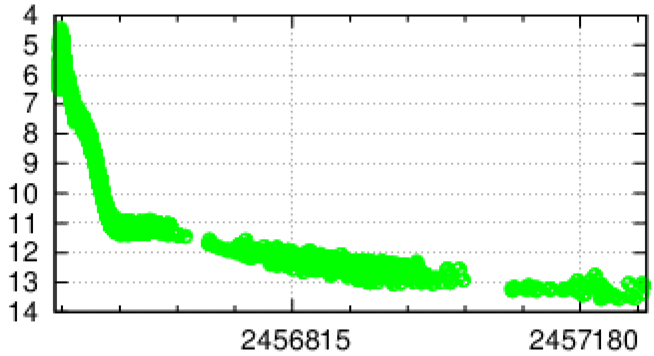
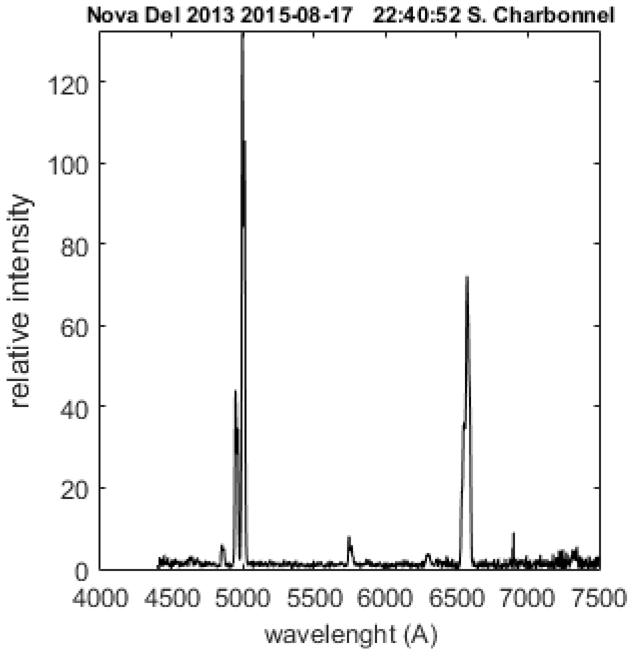
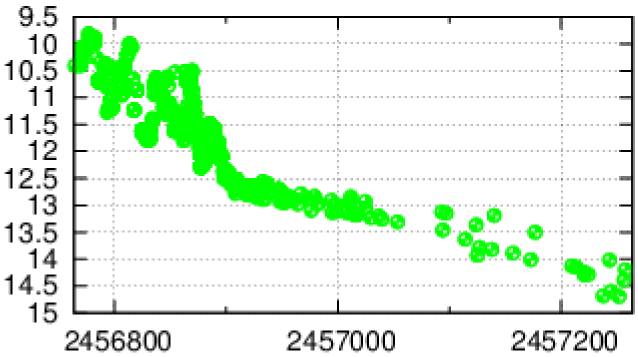
Status of current novae 1/2

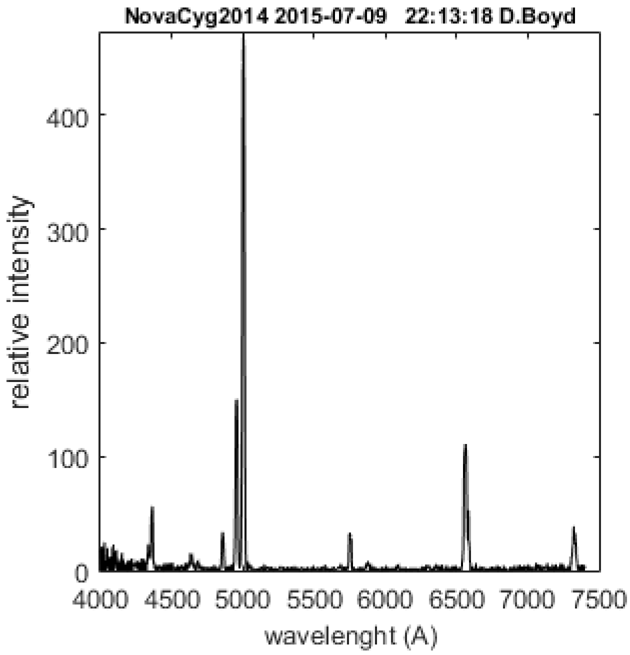
Nova Del 2013	V339 Del
Maximum	14-08-2013
Days after maximum	747
Current mag V	13.5
Delta mag V	9.1



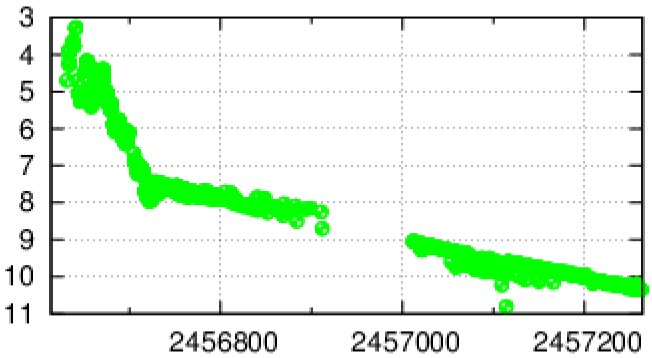


Nova Cyg 2014	V2659 Cyg
Maximum	09-04-2014
Days after maximum	509
Current mag V	14.5
Delta mag V	5





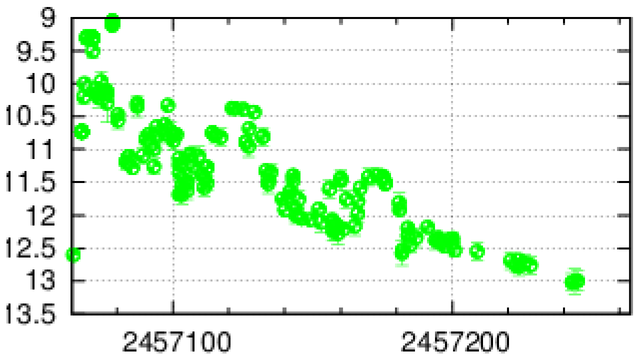
Nova Cen 2013	V1369 Cen
Maximum	14-12-2013
Days after maximum	625
Current mag V	10.3
Delta mag V	7



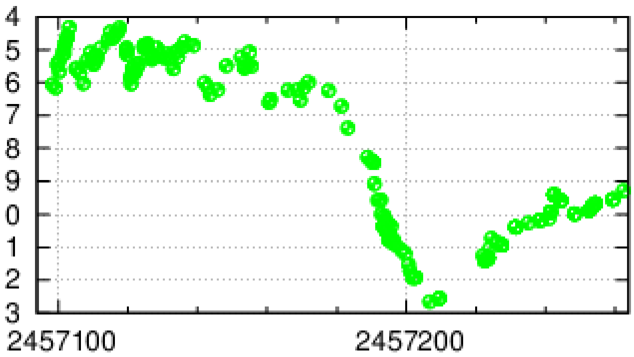
ARAS DATA BASE : http://www.astrosurf.com/aras/Aras_DataBase/Novae.htm

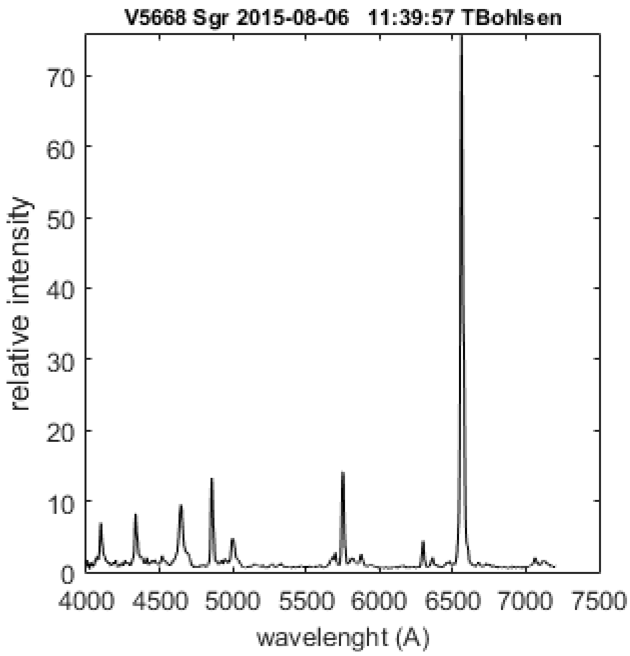
Status of current novae 2/2

NovaSgr 2015	
Maximum	15-02-2015
Days after maximum	200
Current mag V	13
Delta mag V	3.8

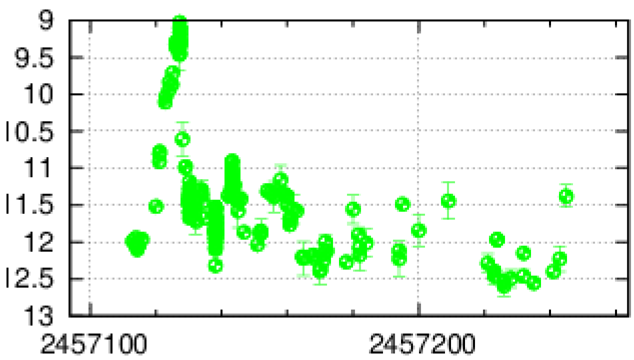


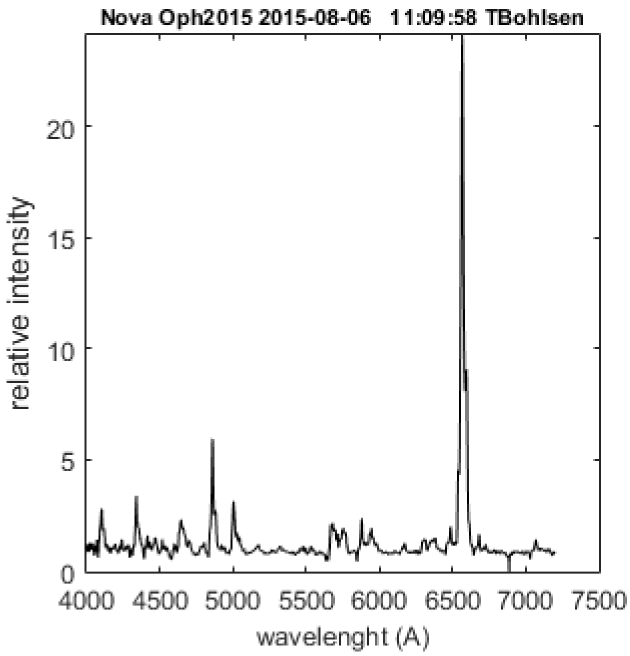
NovaSgr 2015 #2	
Maximum	21-03-2015
Days after maximum	165
Current mag V	9.3
Delta mag V	163





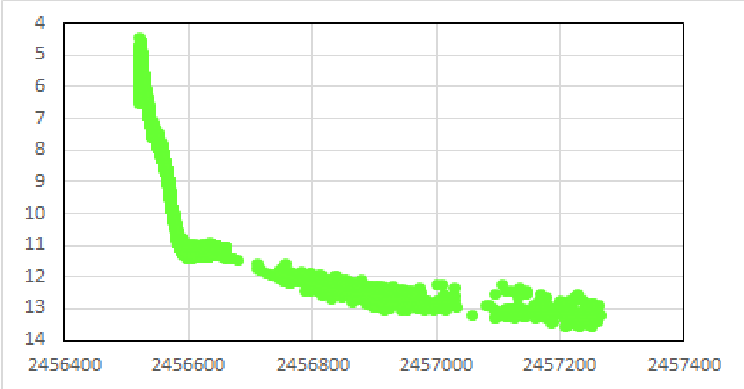
Nova Oph 2015	
Maximum	01-04-2015
Days after maximum	152
Current mag V	12
Delta mag V	3

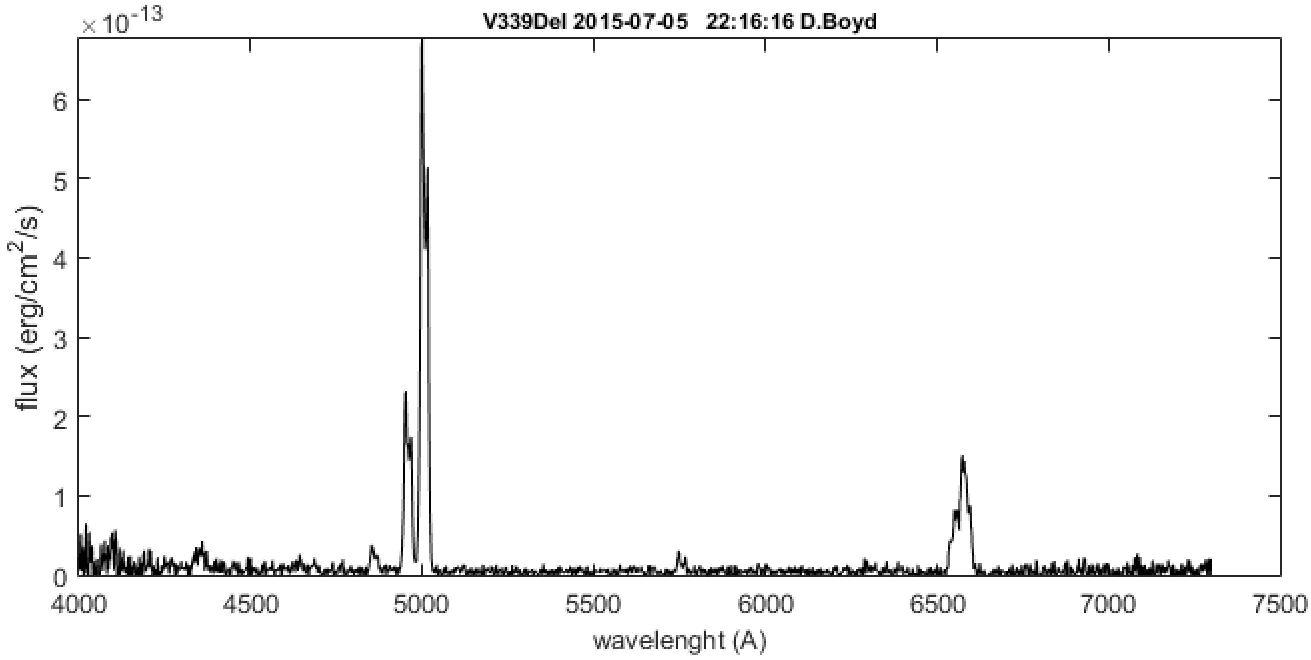


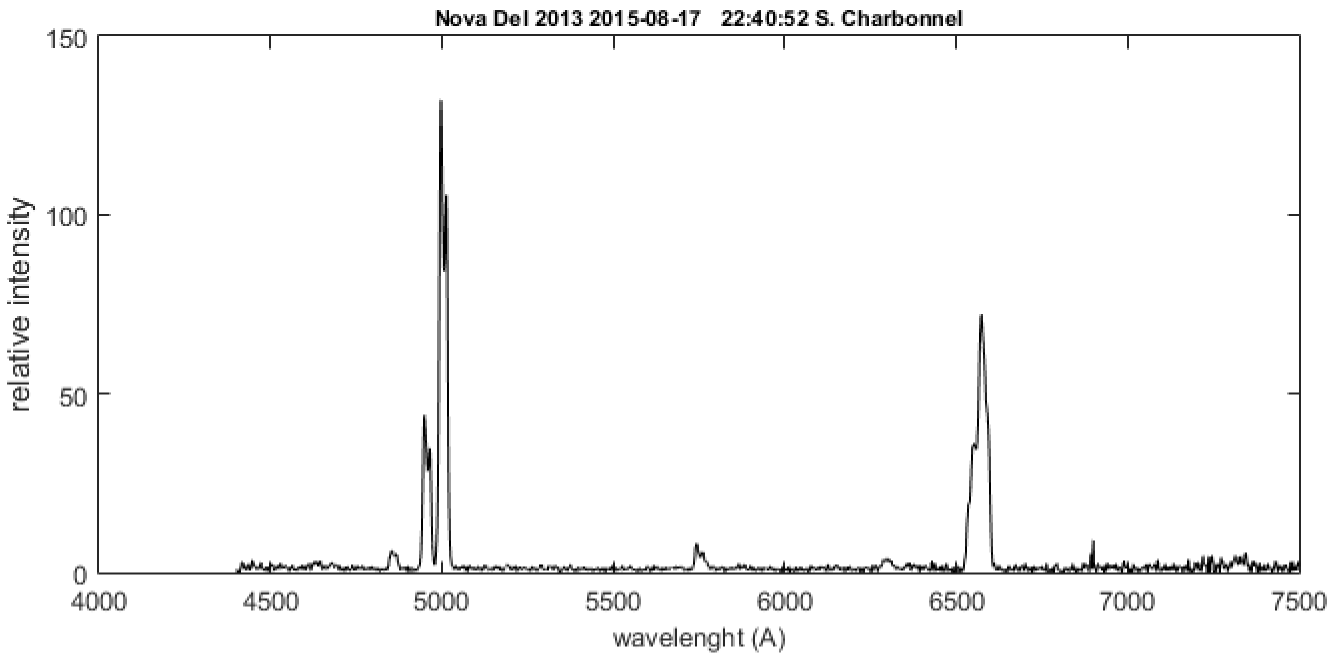


Nova Del 2013 = V 339 Del

The nova continues its slow decline (Mag V = 13.5 , but remains observable





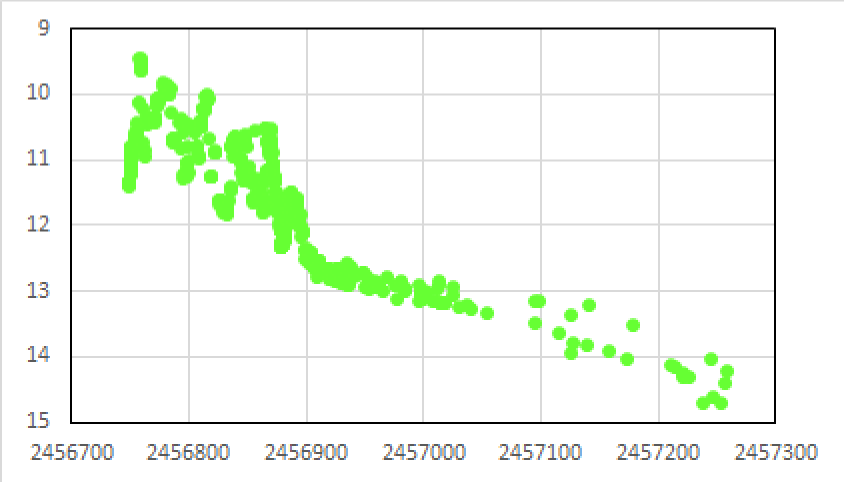


A spectrum obtained by Stéphane Charbonnel at OHP, two years after the discovery (LISA R= 1000)

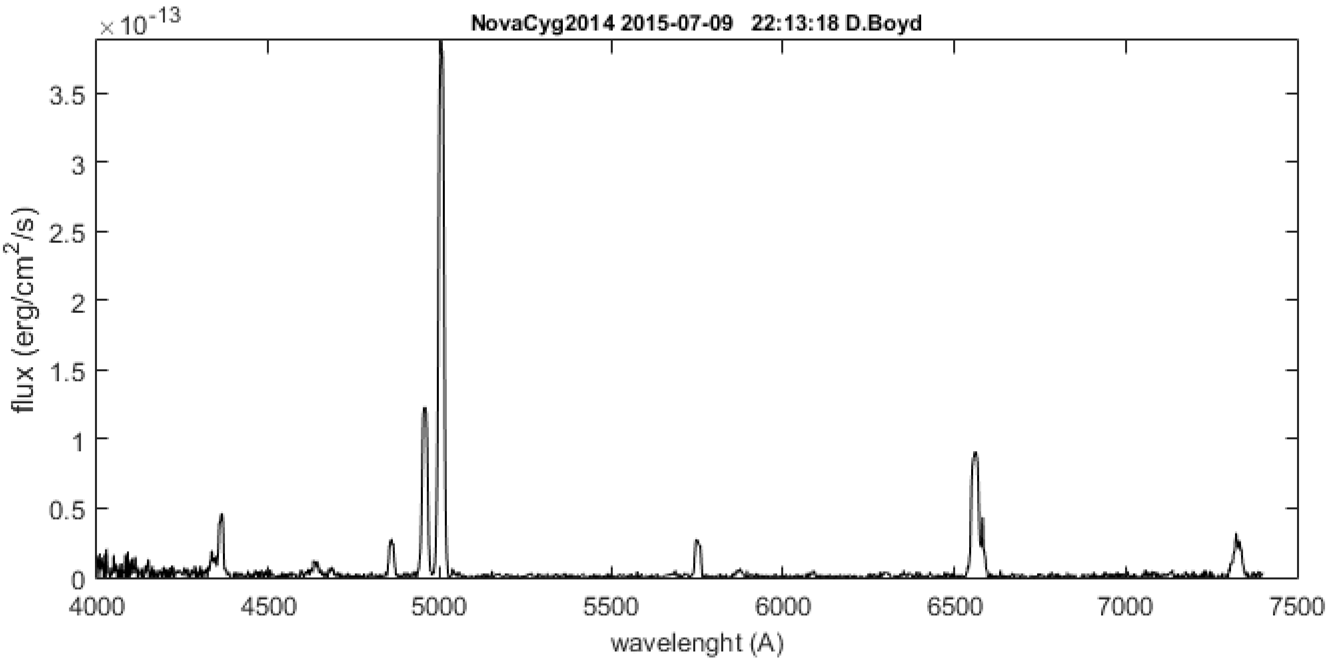
Nova Cyg 2014

Luminosity
Mag V = 14.5 (31-08-2015)

Spectroscopy
Nova Cyg in nebular phase



AAVSO Light Curve (V band)

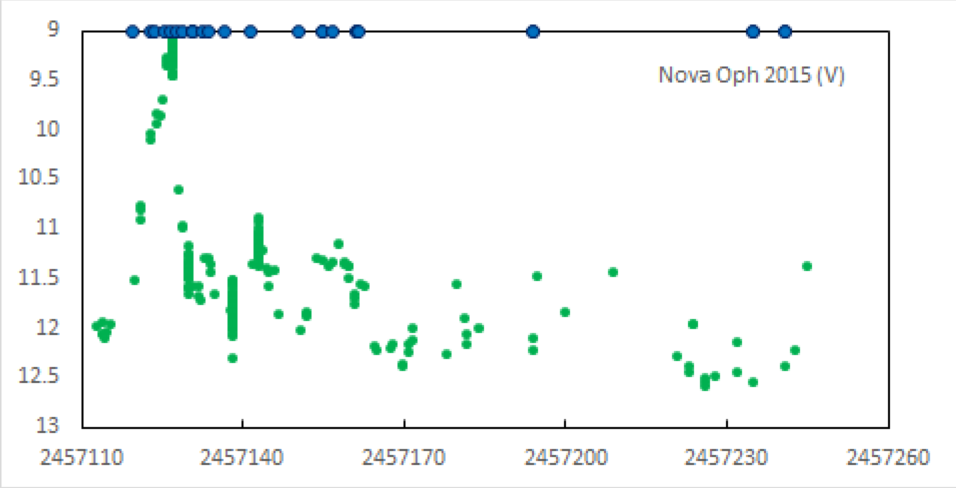


Nova Oph 2015 (PNV J17291350-1846120)

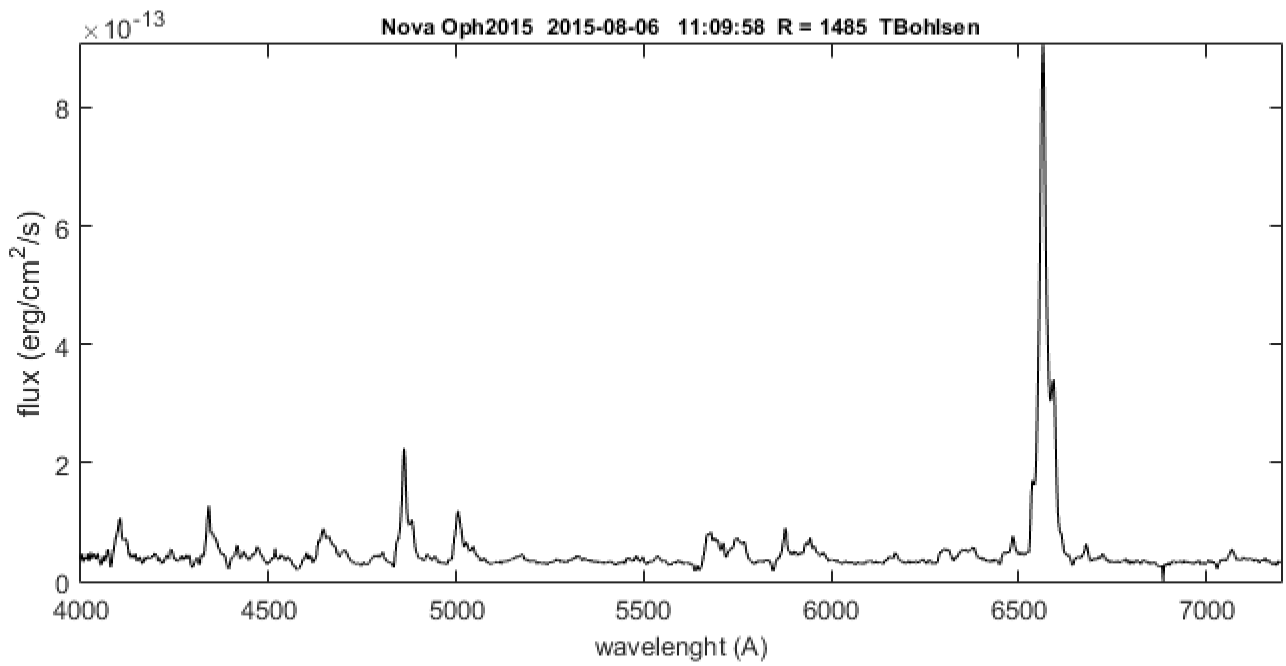
Coordinates (2000.0)	
R.A.	17 29 13.5
Dec.	- 18 46 12

Peculiar light curve : after a fast post maximum decline, the luminosity oscillates between 11.5 and 12.5 (general trend of slow decline)

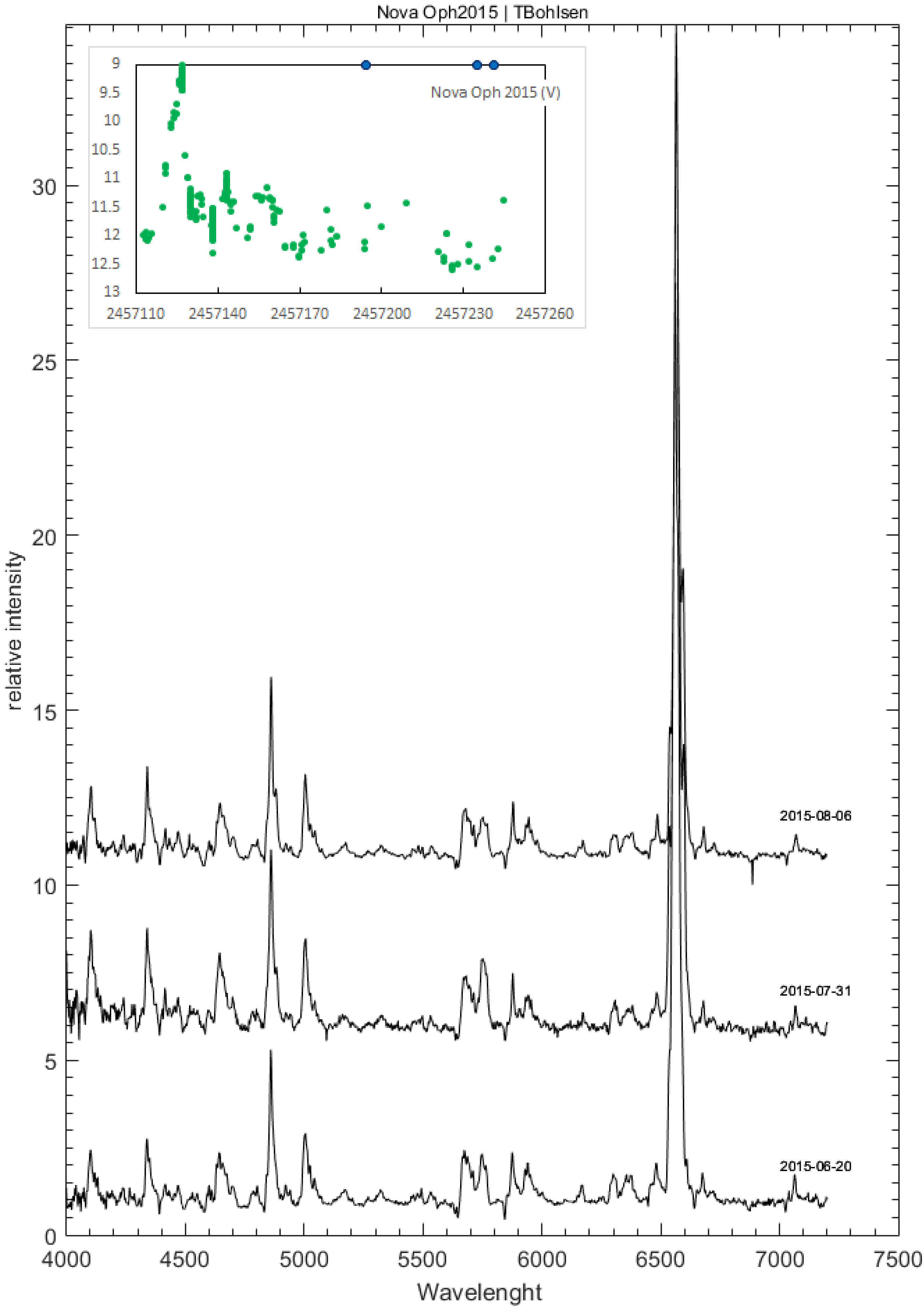
Slight evolution evolution of the spectrum in phase with the luminosity



The AAVSO light curve from 30th of march to 31th of august, 2015
Spectra of ARAS database : blue points

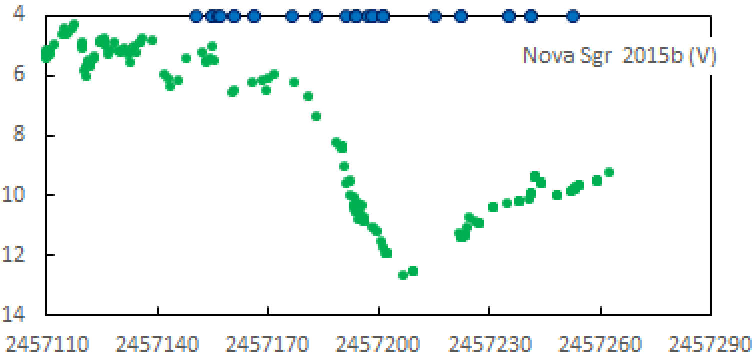


ARAS Data Base : 26 spectra : http://www.astrosurf.com/aras/Aras_DataBase/Novae/2015_NovaOph2015.htm


Nova Oph2015 | TBohlsen
Nova Oph 2015 (V)
9
9.5
10
10.5
11
11.5
12
12.5
13
2457110
2457140
2457170
2457200
2457230
2457260
relative intensity
0
5
10
15
20
25
30
2015-08-06
2015-07-31
2015-06-20
4000
4500
5000
5500
6000
6500
7000
7500
Wavelenght

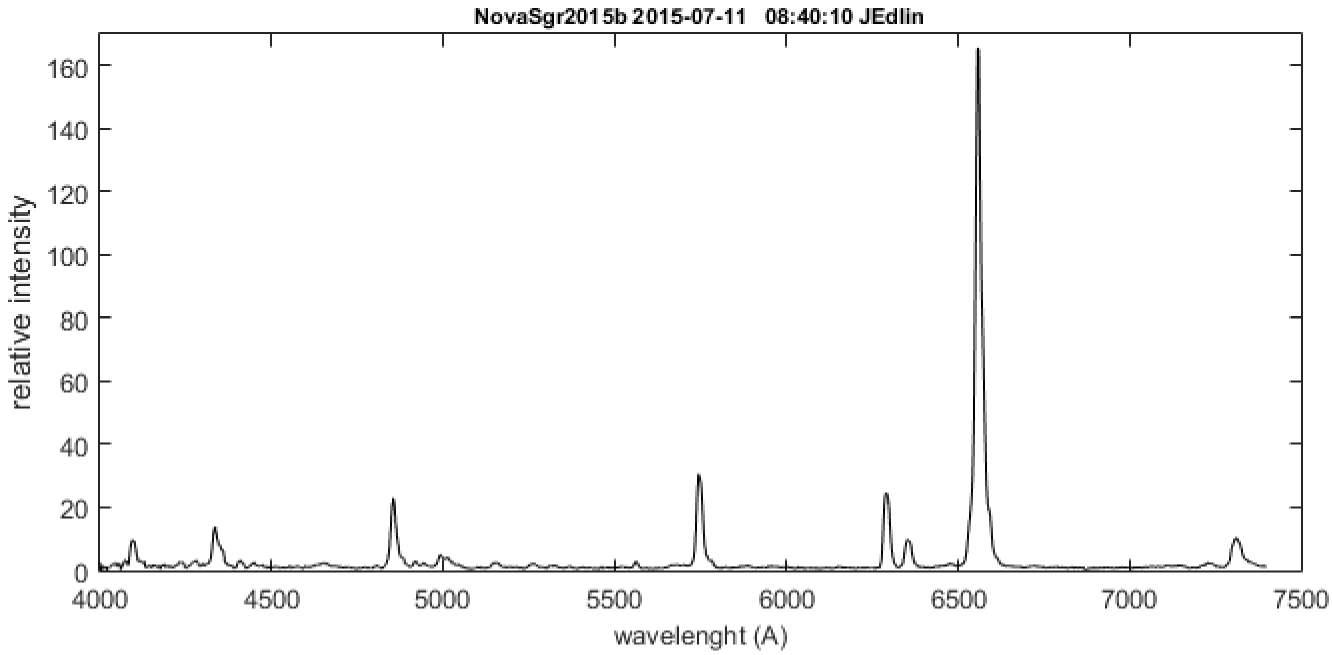
Nova Sgr 2015b = V5668 Sgr

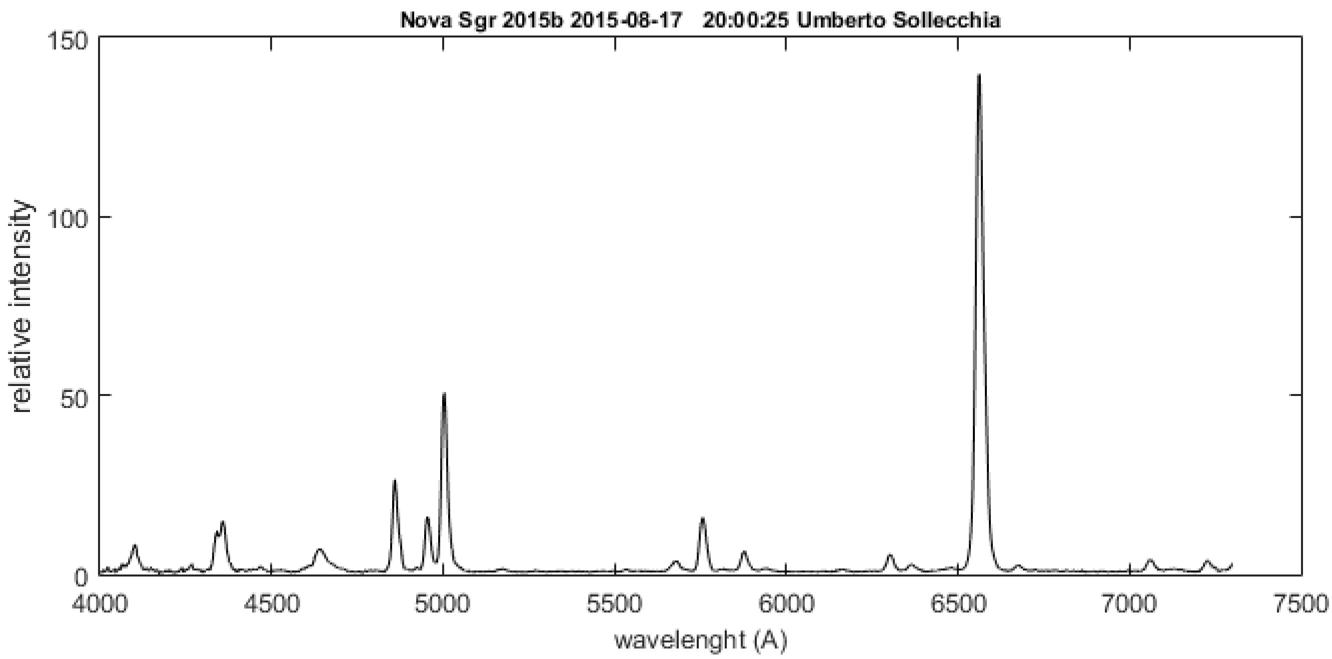
Coordinates (2000.0)	
R.A.	18 36 56.8
Dec.	-28 55 39.8



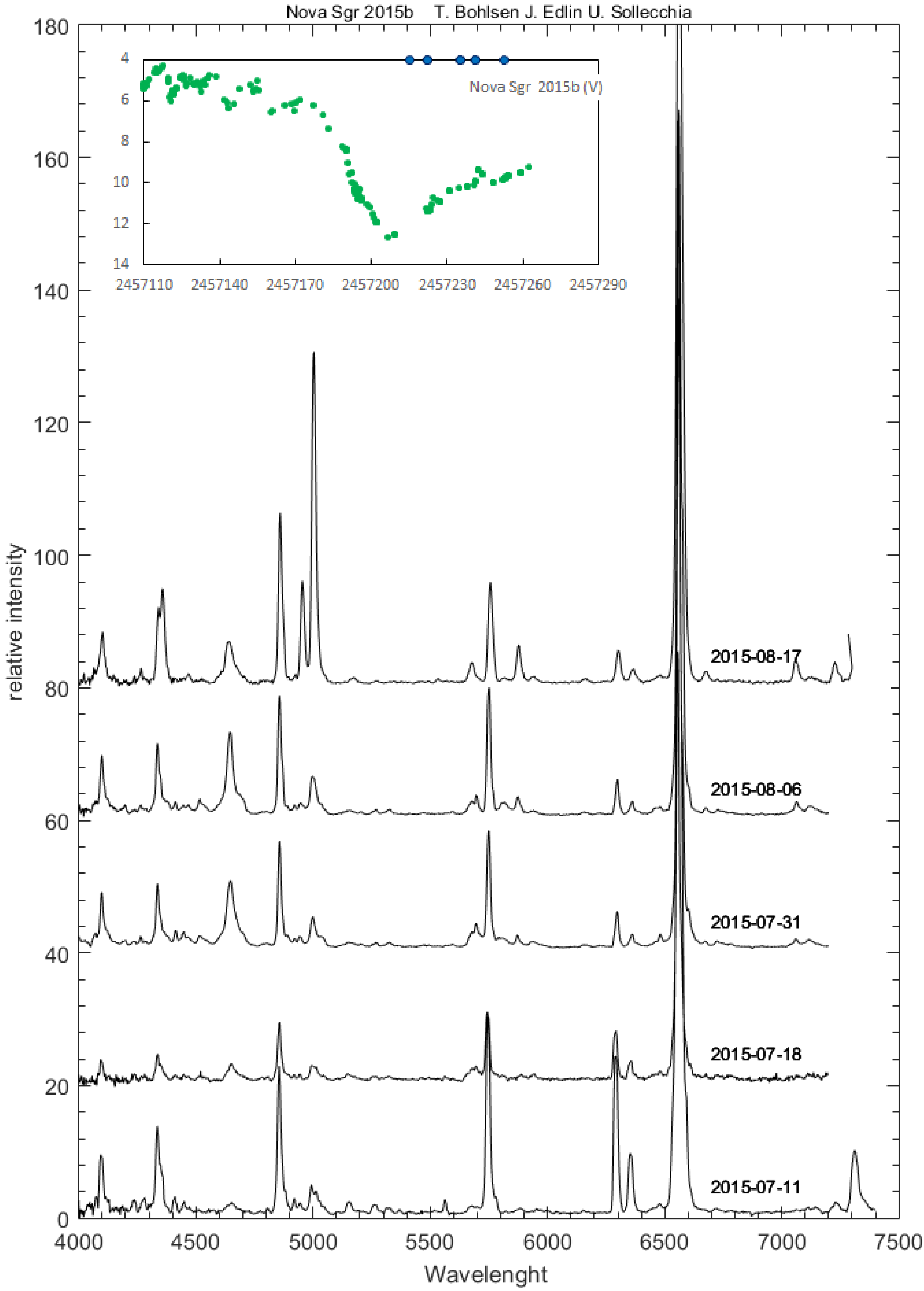
AAVSO light curve (V band)
ARAS Spectra : blue dots

The nova recovers from its dust formation episode.
The fast decline began near JD 2457177 (V = 6.2) and reached a minimum at about JD 24572016 (V = 12.7) with an amplitude of 6.5 mag in V band. The mean slope is 0.22 mag/day.
The raise of luminosity after july, 3 is covered by spectra of T. Bohlsen, J. Edlin and U. Sollecchia.
The I[O III] nebular lines become strong in the latest spectrum (17-08-2015)





Nova Sgr 2015b = V5668 Sgr



Selected list of bright symbiotics stars of interest

Target						Refrence Star					
#	Name	AD (2000)	DE (2000)	Mag V *	Interest	Name	AD (2000)	DE (2000)	Mag V	E(B-V)	Sp Type
1	AX Per	1 36 22.7	54 15 2.5	11.6	++	HD 6961	01 11 06.2	+55 08 59.6	4.33	0	A7V
2	UV Aur	5 21 48.8	32 30 43.1	10		HD 39357	05 53 19.6	+27 36 44.1	4.557		A0V
3	ZZ CMi	7 24 13.9	8 53 51.7	10.2		HD 61887	07 41 35.2	+03 37 29.2	5.955		A0V
4	BX Mon	7 25 24	-3 36 0	10.4	+	HD 55185	07 11 51.9	- 00 29 34.0	4.15		A2V
5	V694 Mon	7 25 51.2	-7 44 8	10.5	++	HD 55185	07 11 51.9	- 00 29 34.0	4.15		A2V
6	NQ Gem	7 31 54.5	24 30 12.5	8.2		HD 64145	07 53 29.8	+26 45 56.8	4.977		A3V
7	T CrB	15 59 30.1	25 55 12.6	10.4	++	HD 143894	16 02 17.7	+22 48 16.0	4.817	0	A3V
8	AG Dra	16 1 40.5	66 48 9.5	9.7	++	HD 145454	16 06 19.7	+67 48 36.5	5.439	0	A0Vn
9	RS Oph	17 50 13.2	-6 42 28.4	10.4	++	HD 164577	18 01 45.2	+01 18 18.3	4.439	0	A2Vn
10	YY Her	18 14 34.3	20 59 20	12.9	++	HD 166014	18 07 32.6	+28 45 45.0	3.837	0.02	B9.5V
11	V443 Her	18 22 8.4	23 27 20	11.3	++	HD 171623	18 35 12.6	+18 12 12.3	5.79	0	A0Vn
12	BF Cyg	19 23 53.4	29 40 25.1	10.8	++	HD 180317	19 15 17.4	+21 13 55.6	5.654	0	A4V
13	CH Cyg	19 24 33	50 14 29.1	7	+	HD 184006	19 29 42.4	+51 43 47.2	3.769	0	A5V
14	CI Cyg	19 50 11.8	35 41 3.2	10.5	++	HD 187235	19 47 27.8	+38 24 27.4	5.826	0.02	B8Vn
15	StHA 190	21 41 44.8	2 43 54.4	10.3	+	HD 207203	21 47 14.0	+02 41 10.0	5.631	0	A1V
16	AG Peg	21 51 1.9	12 37 29.4	8.6	++	HD 208565	21 56 56.4	+12 04 35.4	5.544	0	A2Vnn
18	Z And	23 33 39.5	48 49 5.4	9.65	++	HD 222439	23 40 24.5	+44 20 02.2	4.137	0	A0V
19	R Aqr	23 43 49.4	-15 17 4.2	9.9	++	HD 222847	23 44 12.1	- 18 16 37.0	5.235	0	B9V

Mag V * : 01-04-2014

Observing

CH Cygni campaign
Especially high resolution H alpha
CH Cygni remains at a high level of activity.

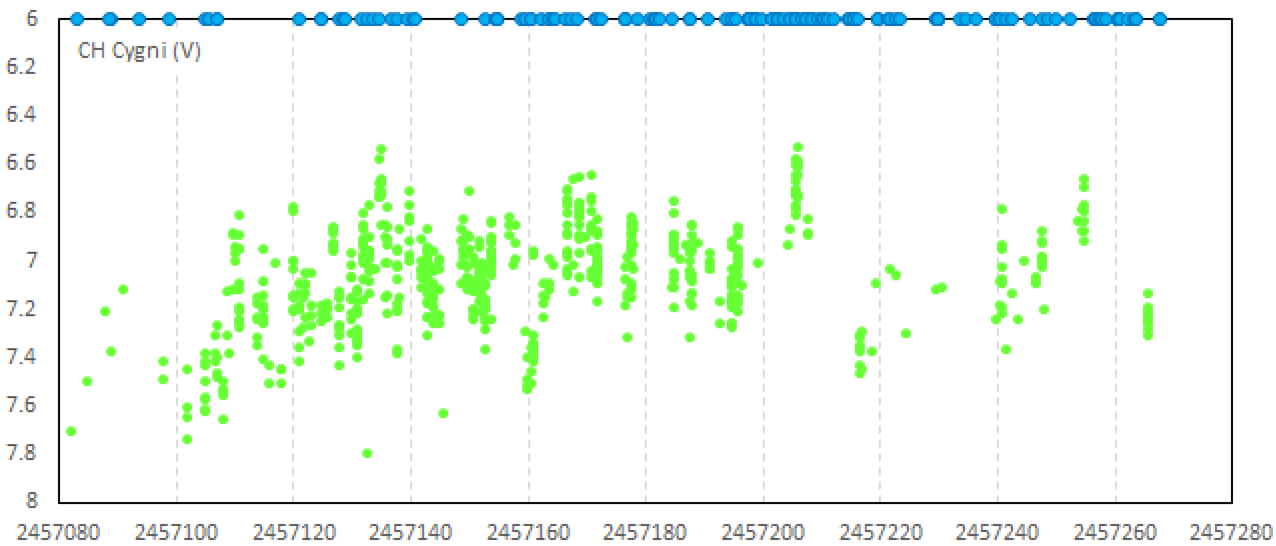
AG Peg : historical outburst

ARAS DATA BASE | http://www.astrosurf.com/aras/Aras_DataBase/Symbiotics.htm

CH Cygni campaign

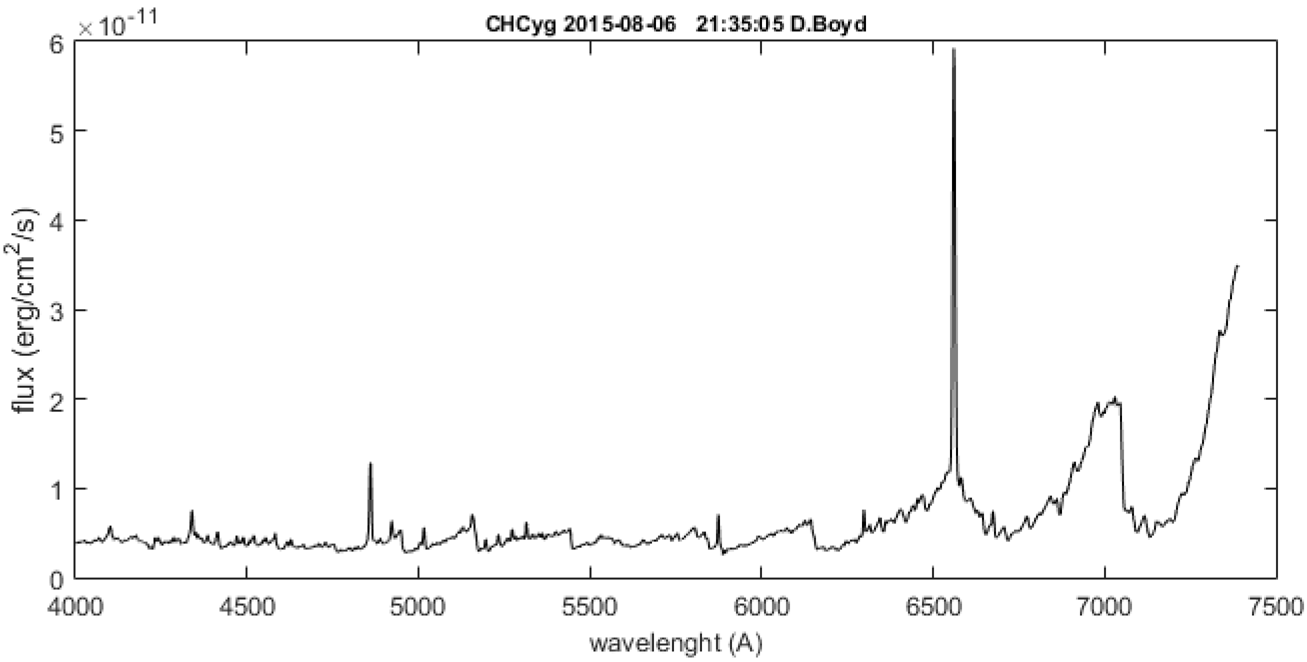
Coordinates (2000.0)	
R.A.	19 24 33.0
Dec.	+50 14 29.1

72 spectra + time series in July and August 2015

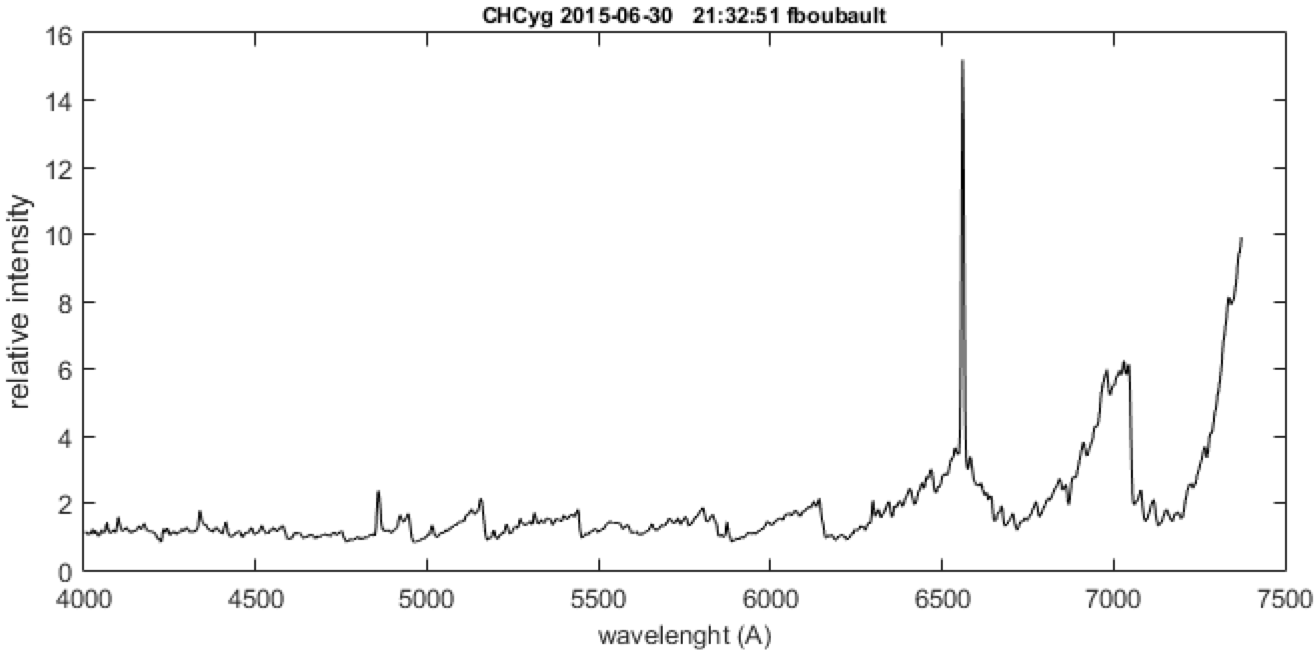


AAVSO V band light curve from march to august, 2015
CH Cyg remains in high state with a flickering of about 0.3-0.4 mag - In June, appears a slowly decreasing trend
ARAS observations : blue dots

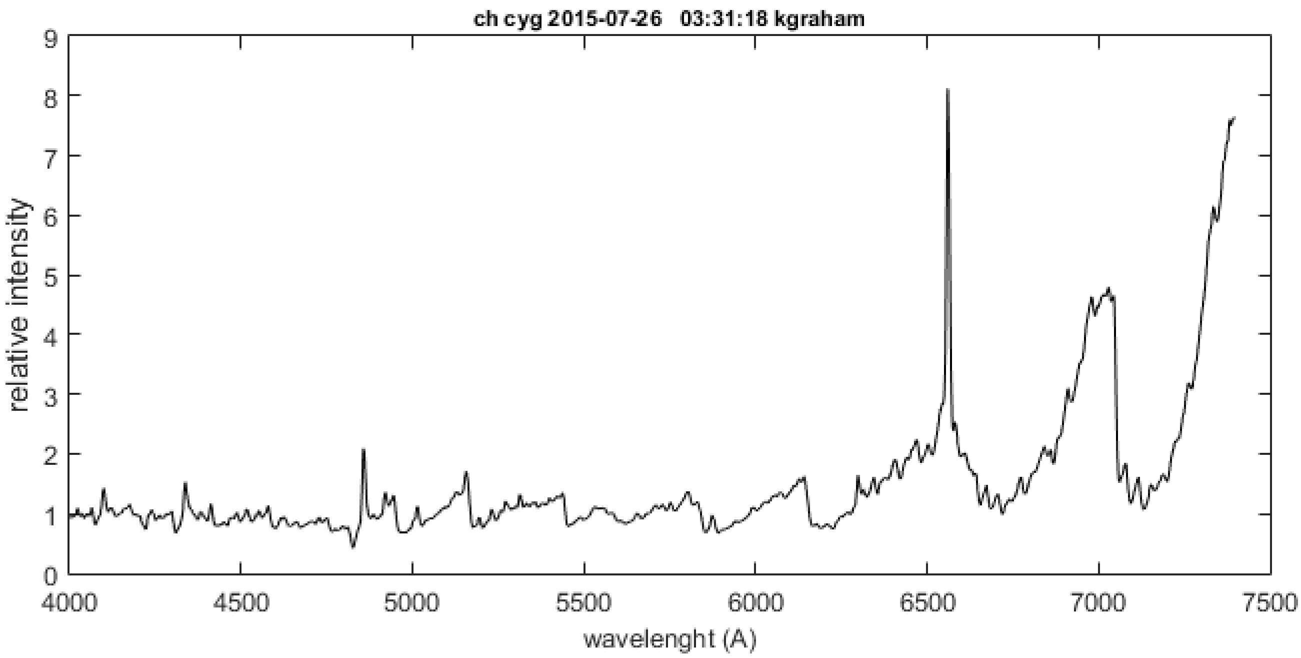
CH Cygni ARAS campaign : see page 22 and previous issues



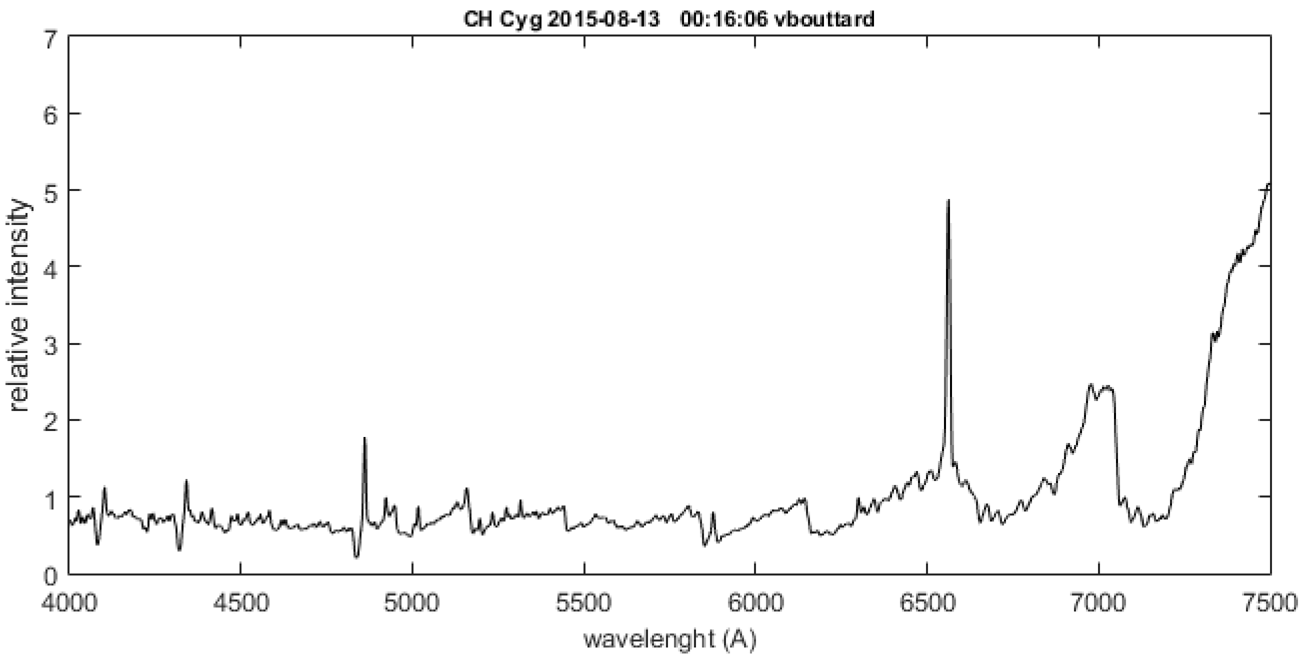
CH Cygni campaign : low resolution spectra in july-august, 2015



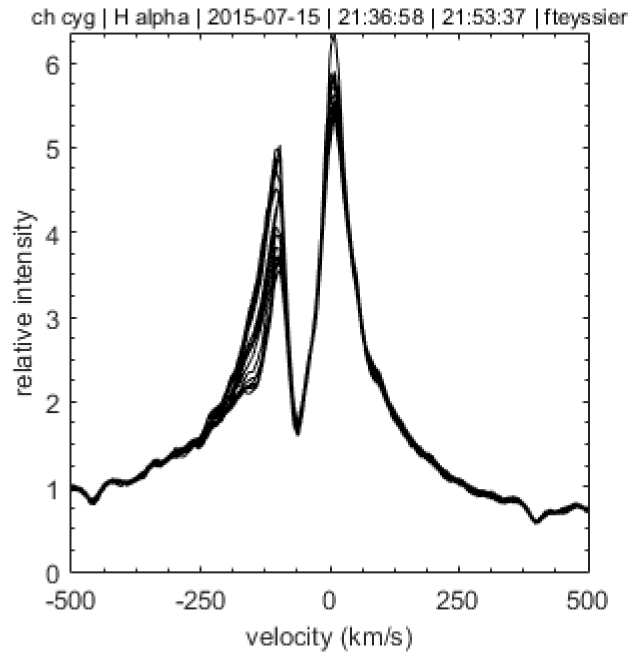
F. Boubault
LISA R = 900

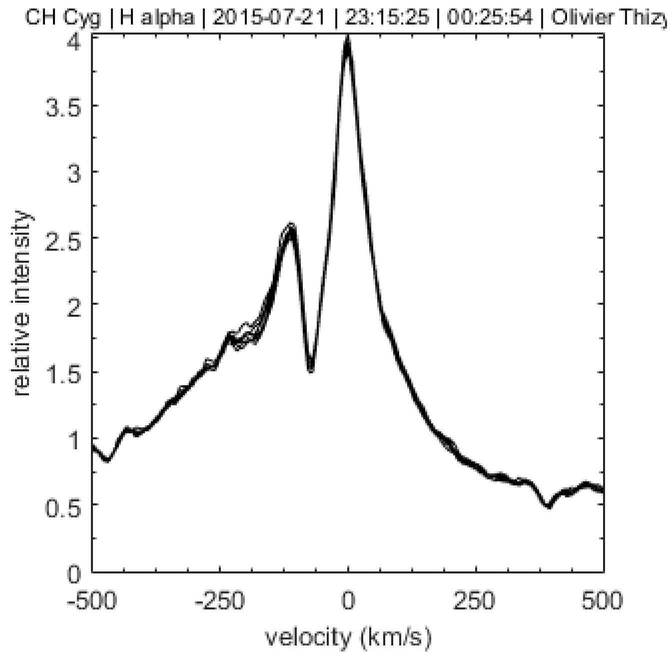


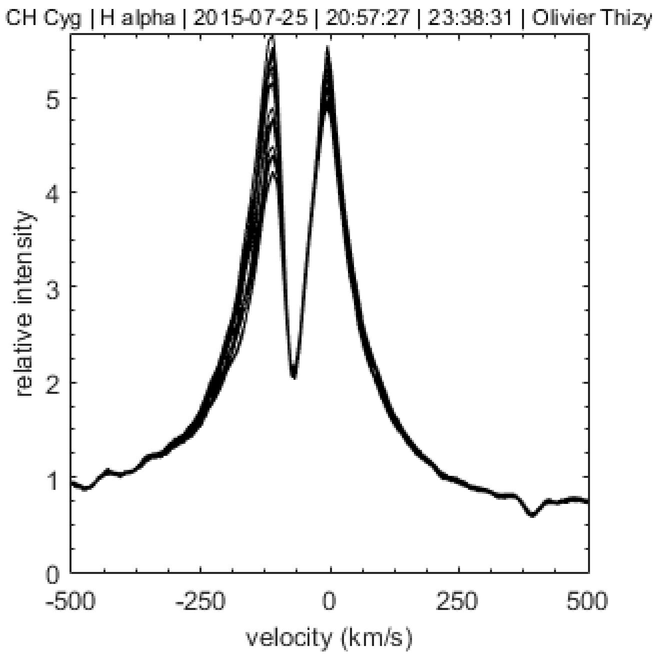
K. Grahm
ALPY R = 600

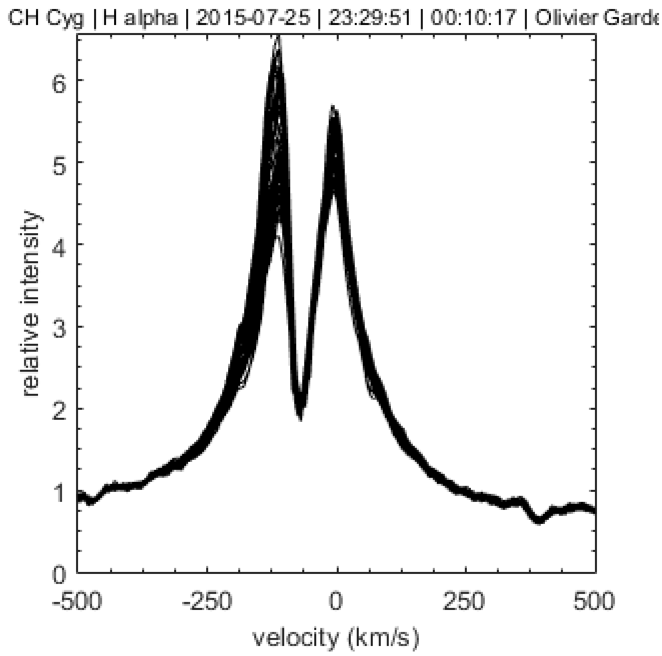


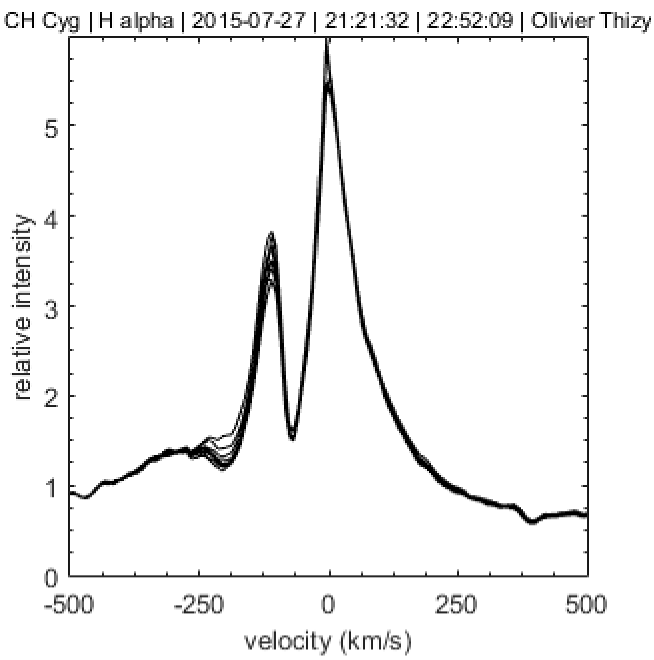
V. Bouttard
ALPY R = 600

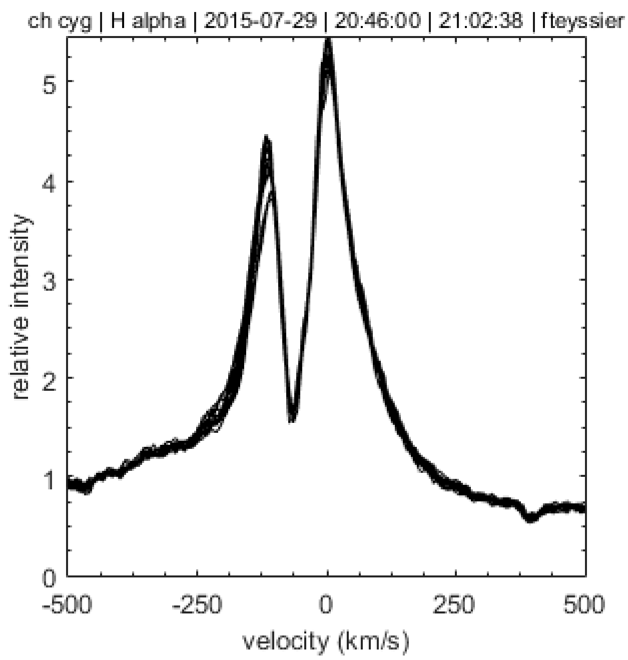

ch cyg | H alpha | 2015-07-15 | 21:36:58 | 21:53:37 | fteyssier
relative intensity
velocity (km/s)

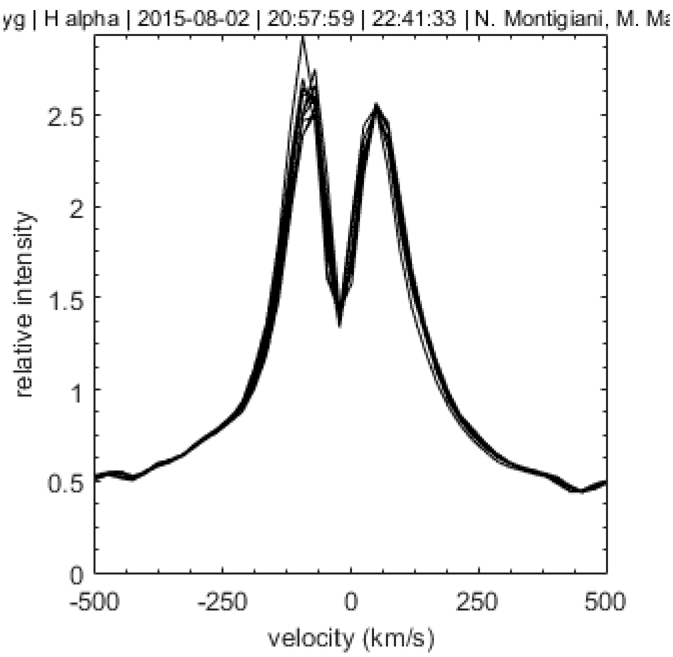

CH Cyg | H alpha | 2015-07-21 | 23:15:25 | 00:25:54 | Olivier Thizy
relative intensity
velocity (km/s)

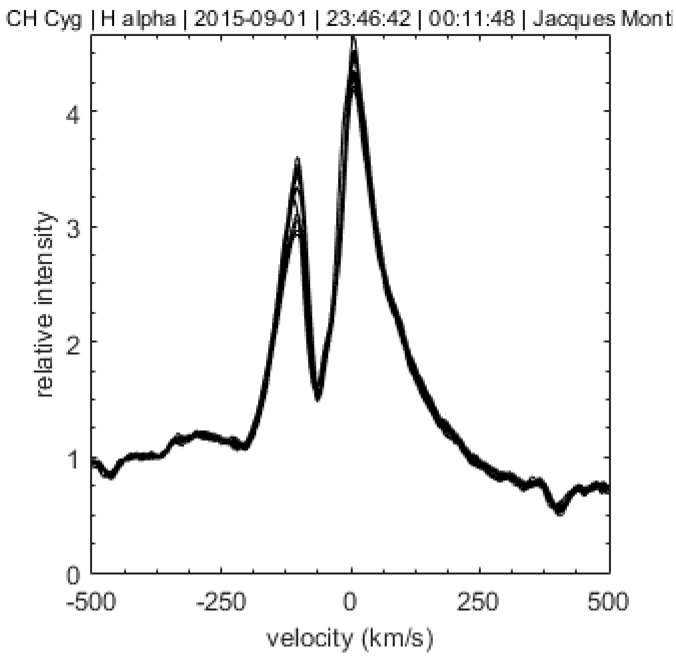

CH Cyg | H alpha | 2015-07-25 | 20:57:27 | 23:38:31 | Olivier Thizy
relative intensity
velocity (km/s)


CH Cyg | H alpha | 2015-07-25 | 23:29:51 | 00:10:17 | Olivier Garde
relative intensity
velocity (km/s)

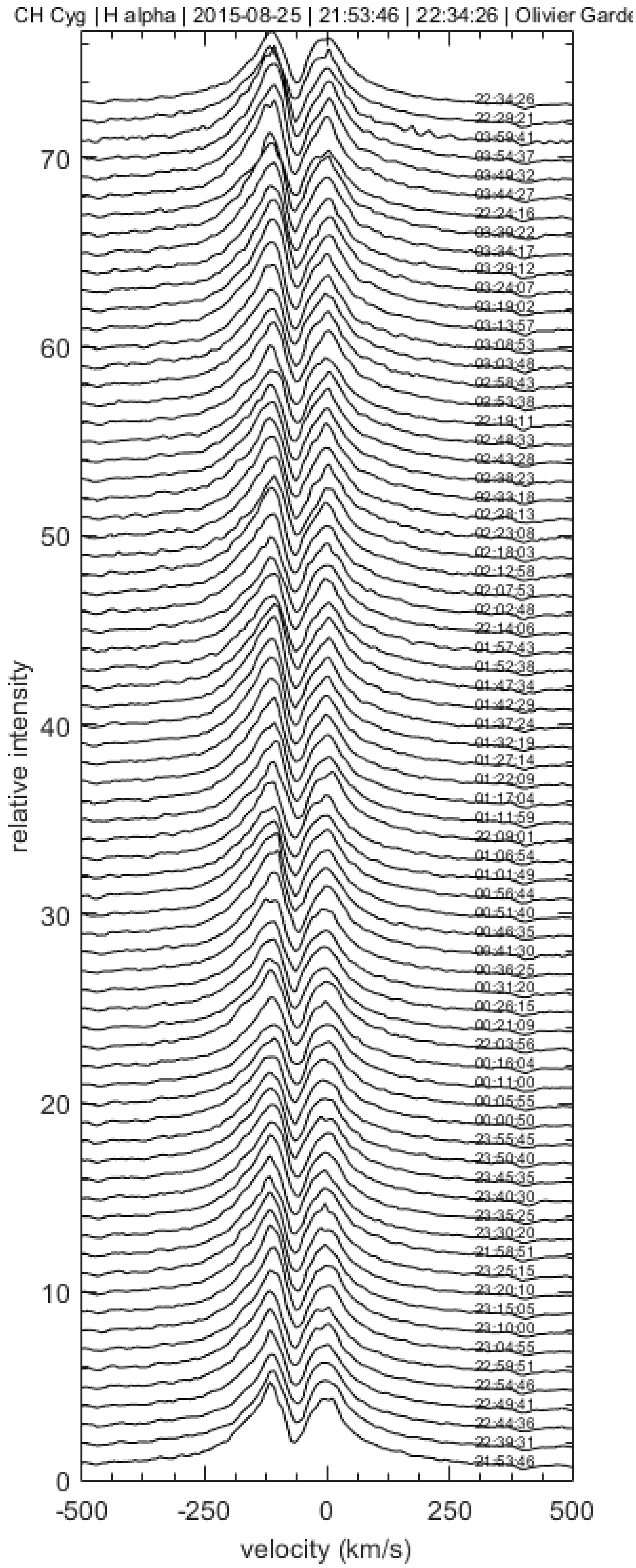

CH Cyg | H alpha | 2015-07-27 | 21:21:32 | 22:52:09 | Olivier Thizy
relative intensity
velocity (km/s)


ch cyg | H alpha | 2015-07-29 | 20:46:00 | 21:02:38 | fteyssier
relative intensity
velocity (km/s)

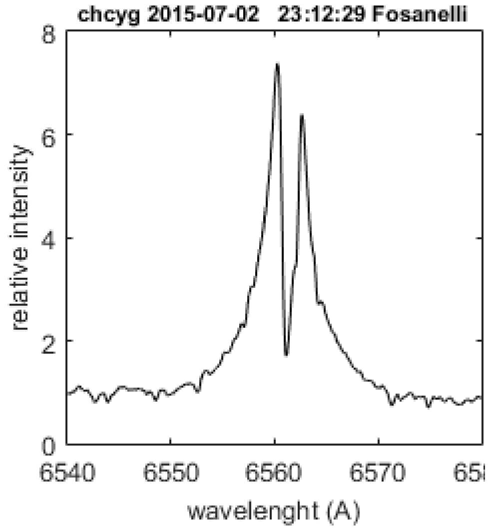

yg | H alpha | 2015-08-02 | 20:57:59 | 22:41:33 | N. Montigiani, M. Ma
relative intensity
velocity (km/s)
0
0.5
1
1.5
2
2.5
-500
-250
0
250
500

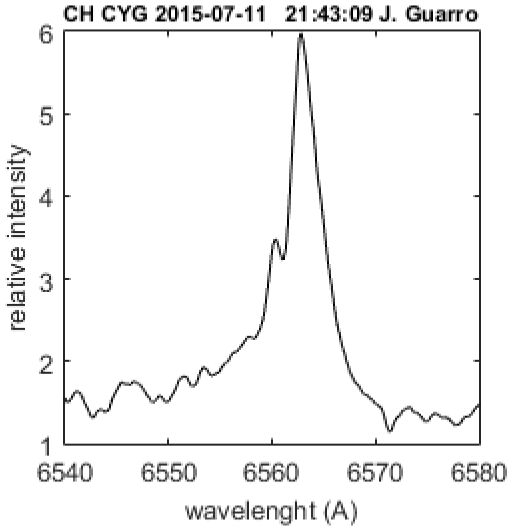

CH Cyg | H alpha | 2015-09-01 | 23:46:42 | 00:11:48 | Jacques Mont
relative intensity
velocity (km/s)
0
1
2
3
4
-500
-250
0
250
500

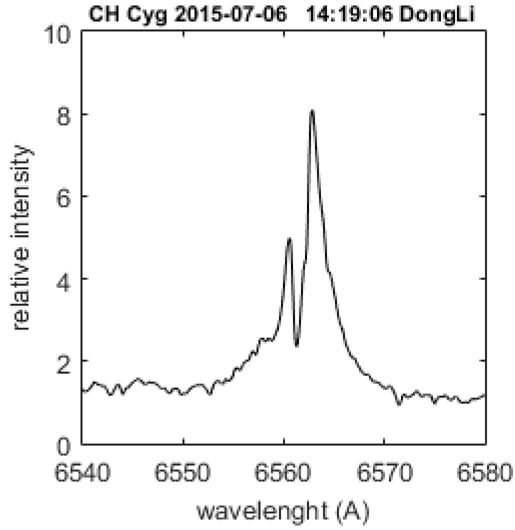
Evolution of Ha line
25-08-2015 during ~ 1.5 hour
Olivier Garde
25-08-2015
R = 11 000

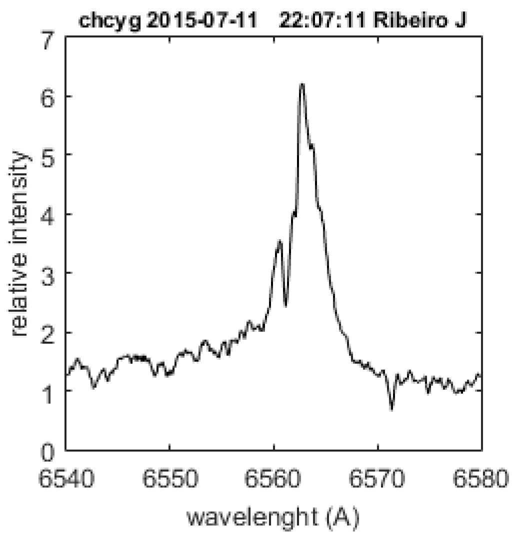


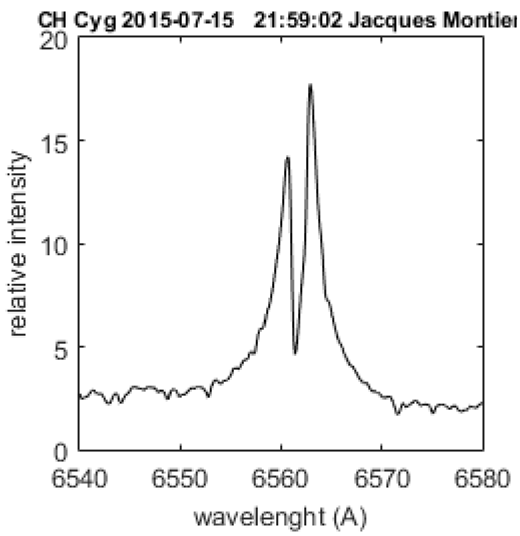
CH Cygni campaign : Ha profiles at resolution from 6000 to 12000

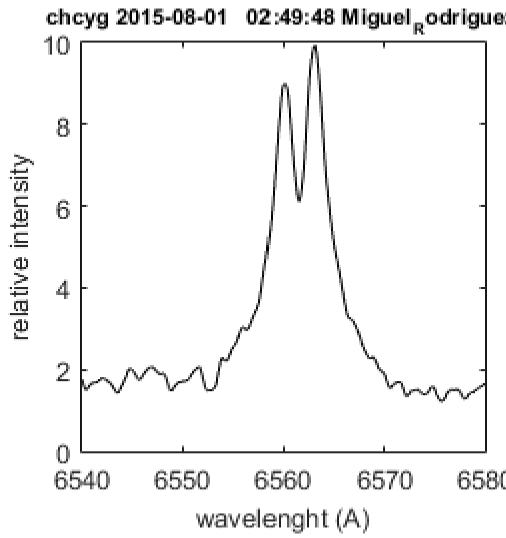


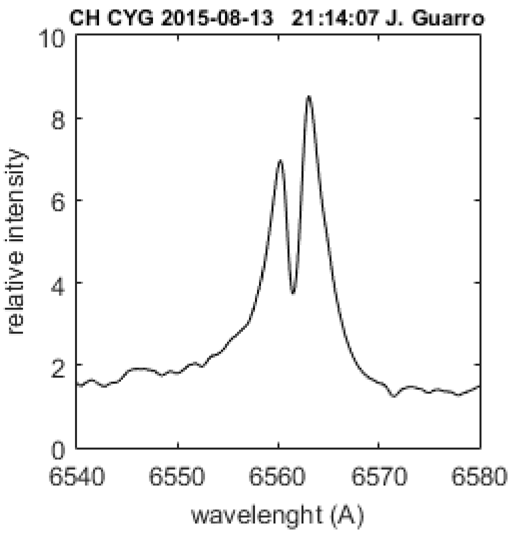


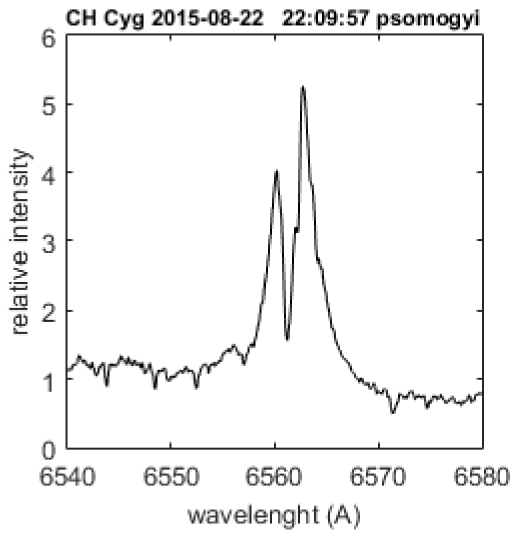


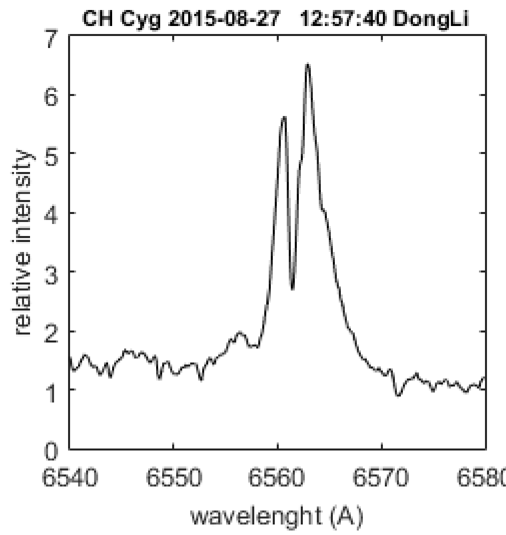






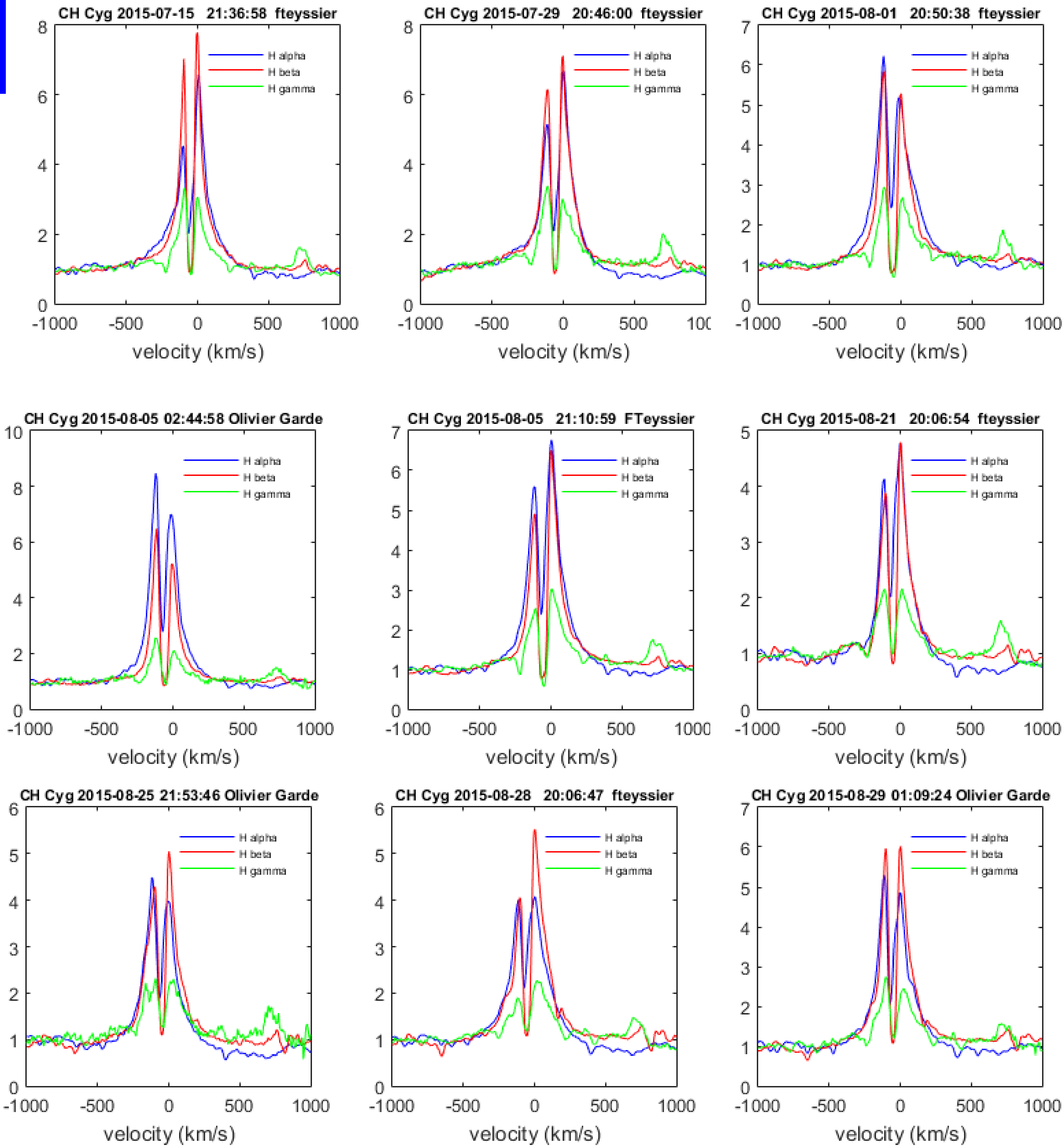




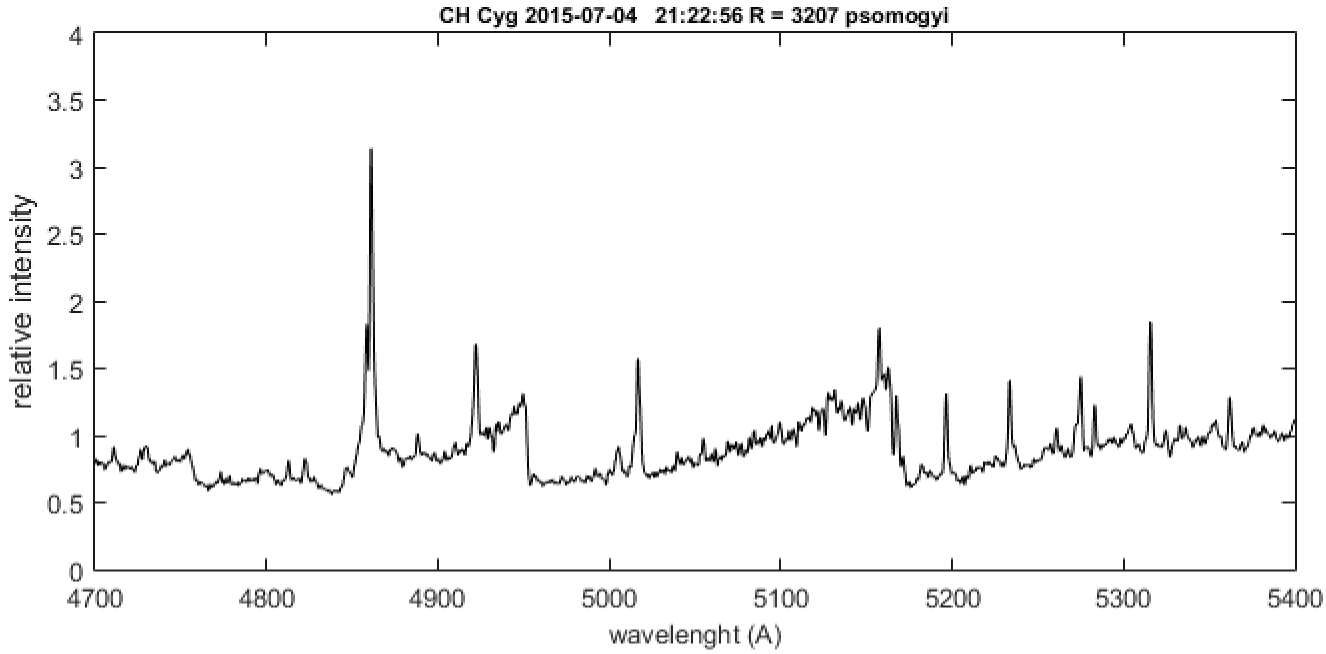


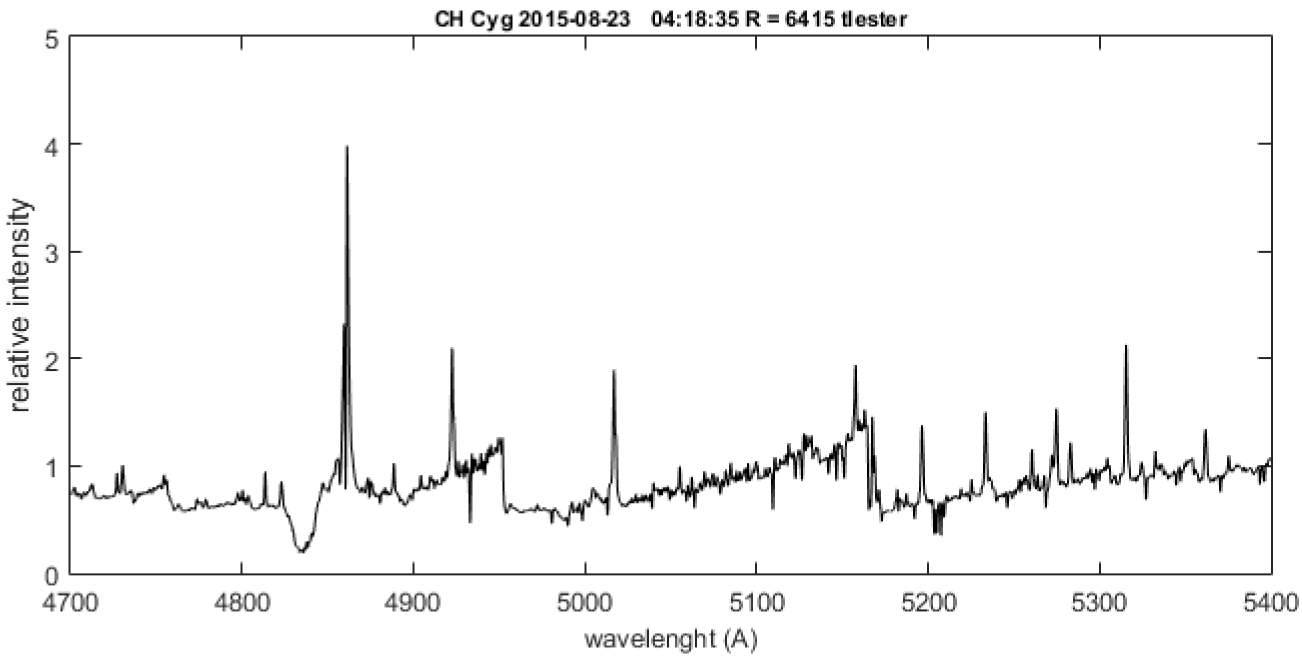
CH Cygni campaign : Balmer lines

Continuum = 1 at v = - 900 km/



H beta region at medium resolution
P. Somogyi & T. Lester





Request for observations of the symbiotic star CH Cygni (Dr A. Skopal)

Field of CH Cygni - Christian Buil - 15-03-2012

CH Cygni

Coordinates (2000.0)	
R.A.	19 24 33
Dec.	+54 14 29.1

Current magnitude V = 7.4 to 7.6
(Flickering)

Reference stars

MILES Standart for high resolution spectra

Name	RA (2000)	Dec (20002)	Sp. Type	Mag. V	E_{B-V}
HD 192640	20:14:31.9	+36:48:22.7	A2V	4.96	0.026

Reference for low resolution spectra

Name	RA (2000)	Dec (20002)	Sp. Type	Mag. V	E_{B-V}
HD 183534	19:27:42	+52:19:14	A1V	5.7	0

Observing

High resolution spectra
Eshel
LHIRES III 2400 l/mm (H alpha)
Spectra should be corrected for heliocentric velocity

Low resolution spectra (minimum R = 600)
With an excellent correction of atmospheric/intrumental response for computation of the SED

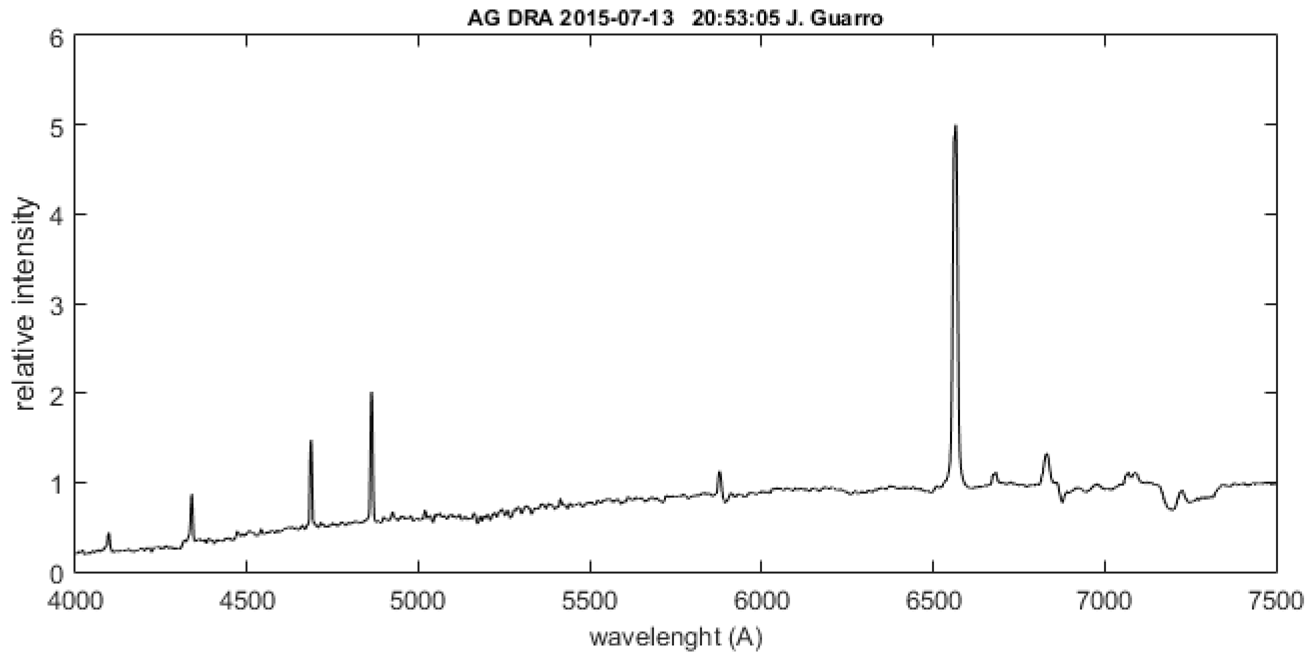
Send spectra
To francoismathieu.teyssier at bbox.fr

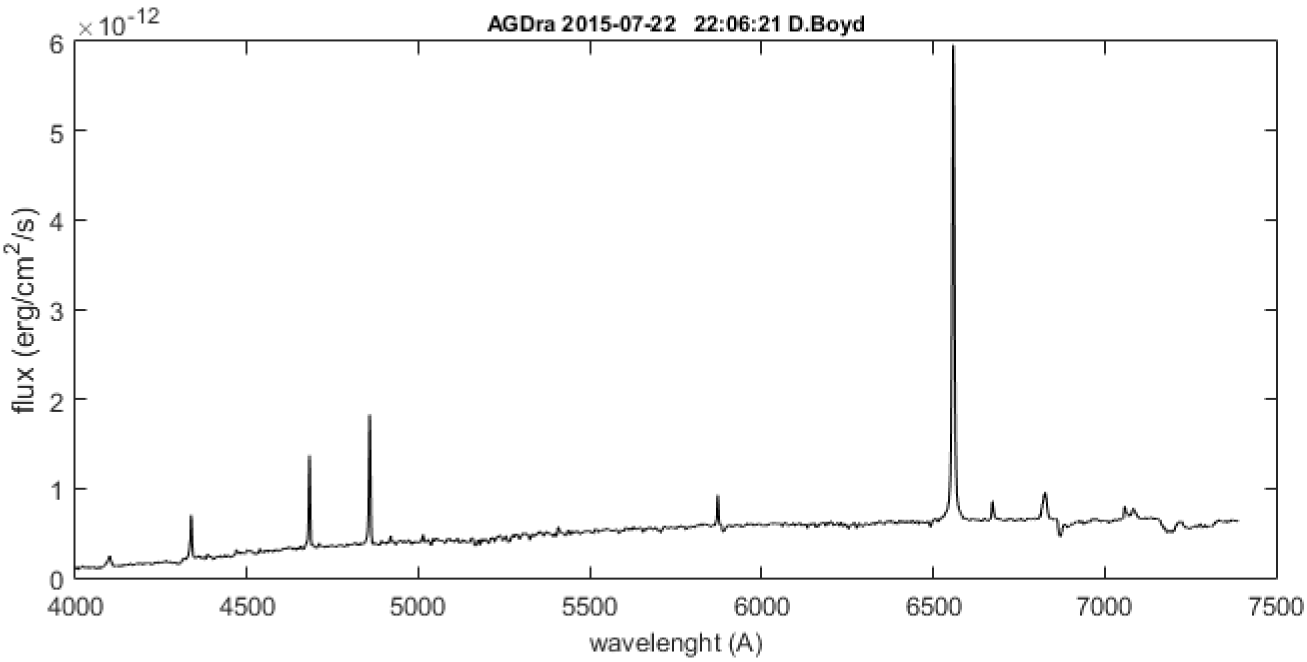
File name : _chcygni_aaaammdd_hhh.fit
And _chcygni_aaaammdd_hhh.zip for eShel and Time series

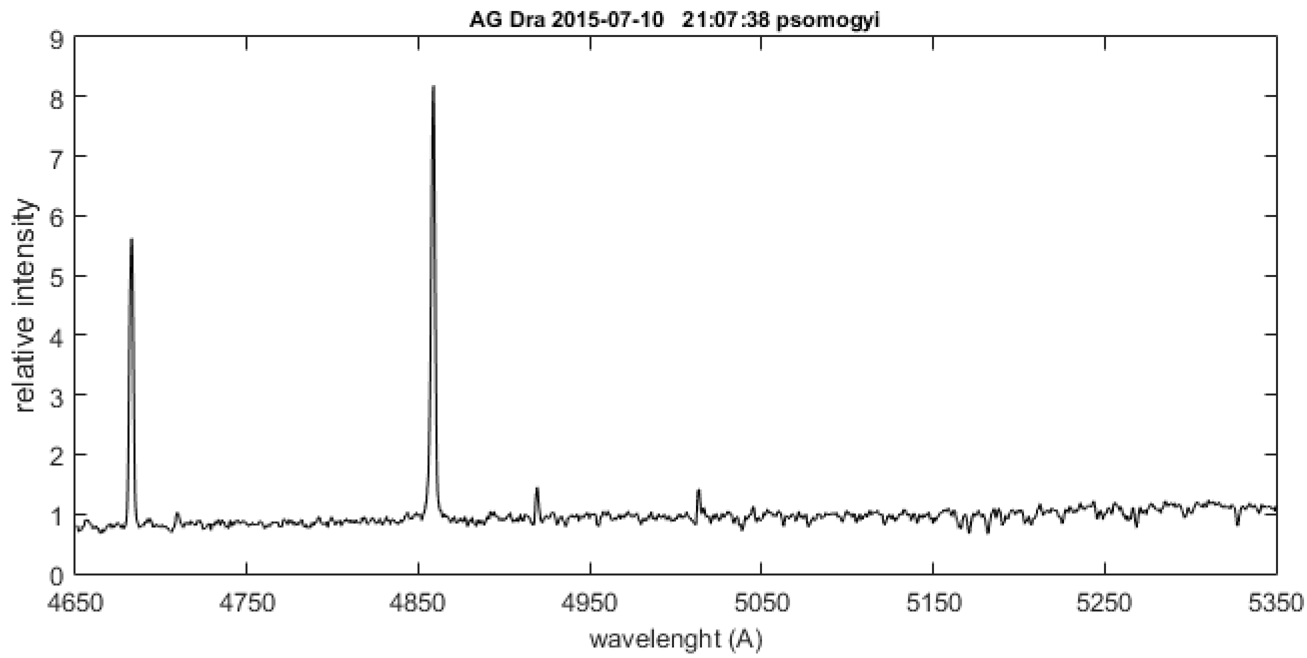
ARAS Data Base for CH Cygni
http://www.astrosurf.com/aras/Aras_DataBase/Symbiotics/CHCyg.htm

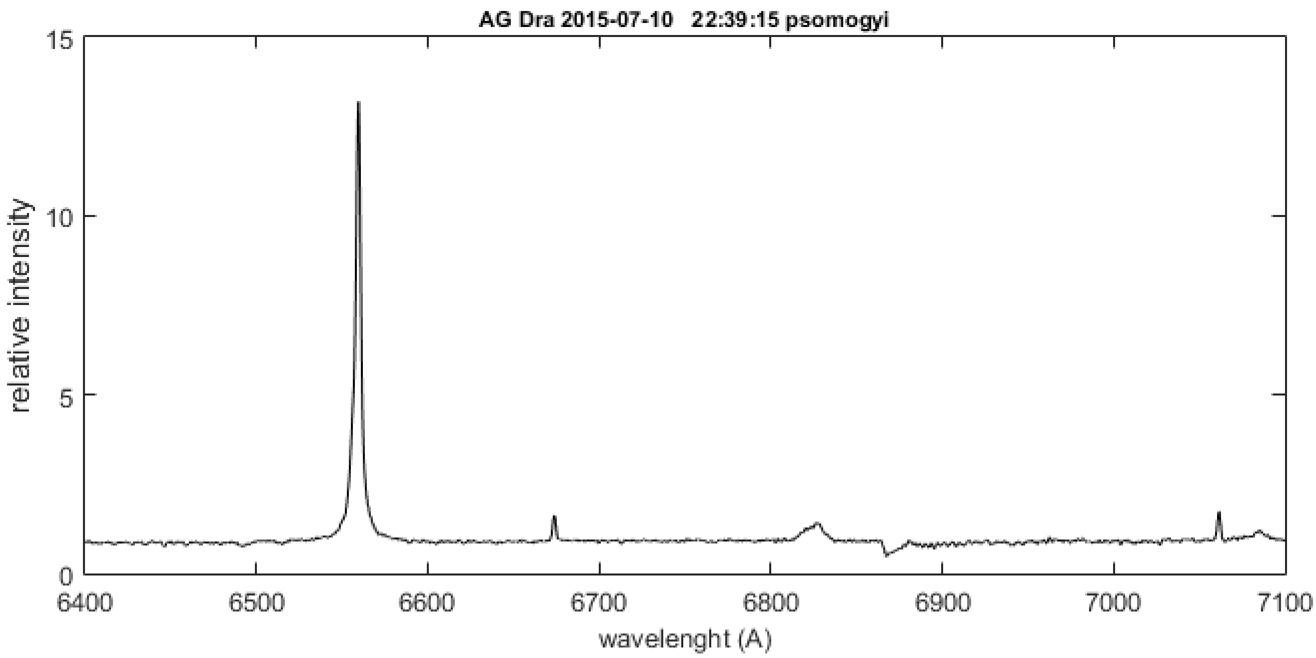
AG Dra : short flare late may

Coordinates (2000.0)	
R.A.	16 01 41.0
Dec.	+66 48 10.1
Mag V	9.7





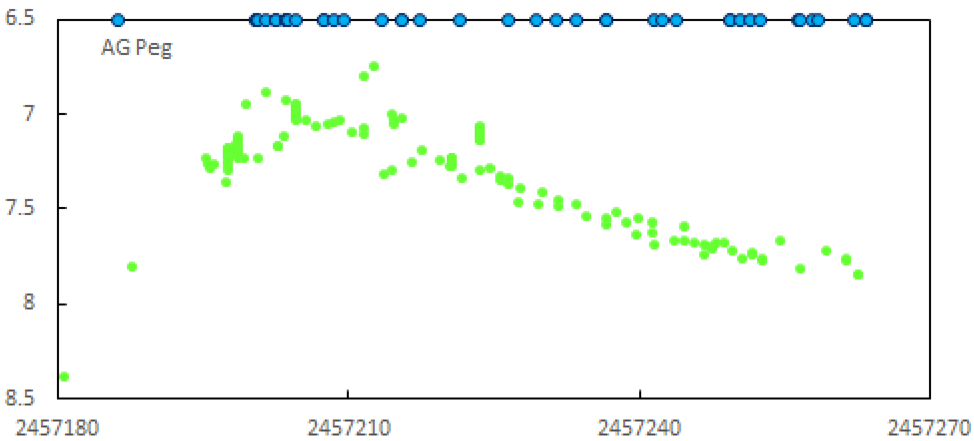

AG Dra 2015-07-10 21:07:38 psomogyi
relative intensity
wavelenght (A)
0
1
2
3
4
5
6
7
8
9
4650
4750
4850
4950
5050
5150
5250
5350

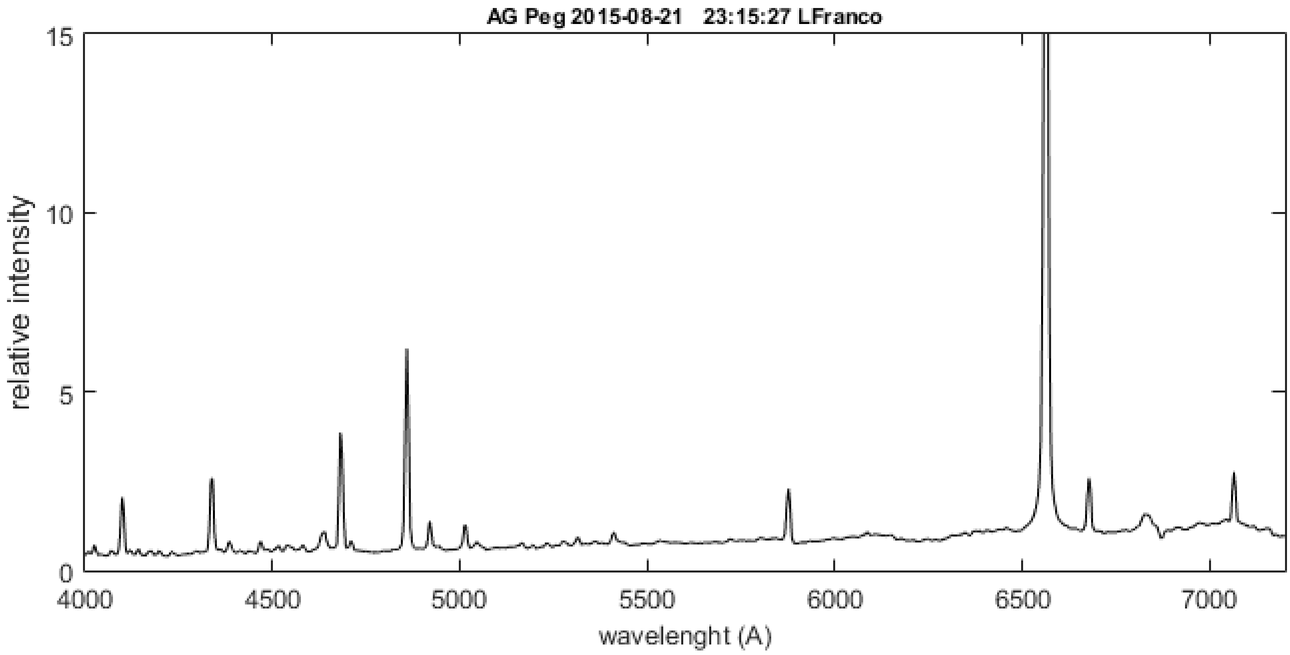

AG Dra 2015-07-10 22:39:15 psomogyi
relative intensity
wavelenght (A)
0
5
10
15
6400
6500
6600
6700
6800
6900
7000
7100

AG Peg in outburst : an historical event

Coordinates (2000.0)	
R.A.	19 23 53.5
Dec.	+29 40 29.2

The V luminosity is declining during this historical symbiotic outburst

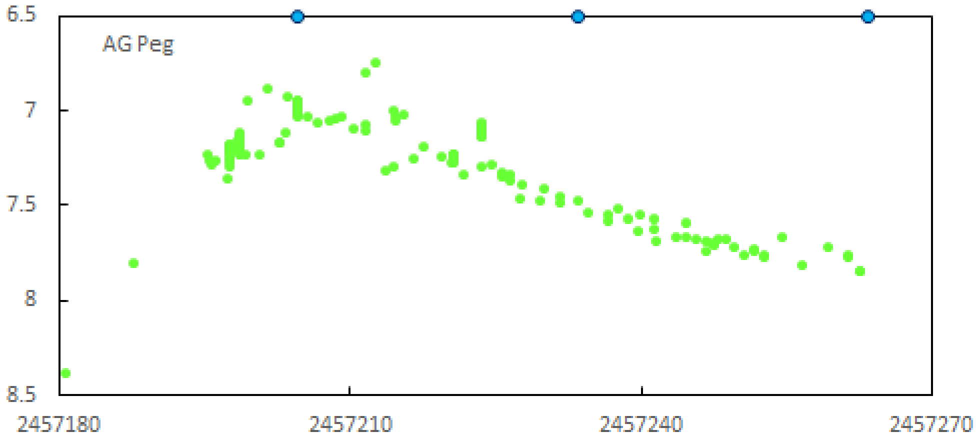


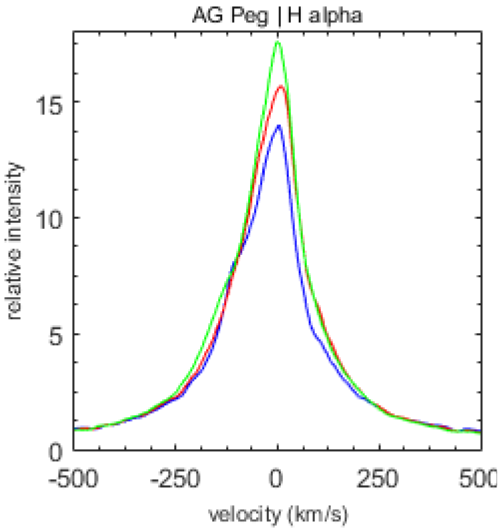


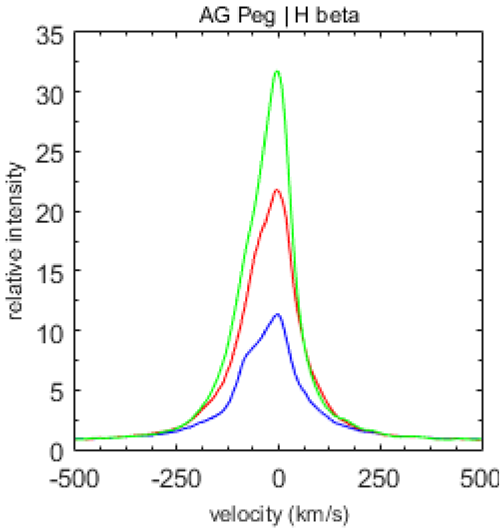
AG Peg : evolution of lines at R = 11000

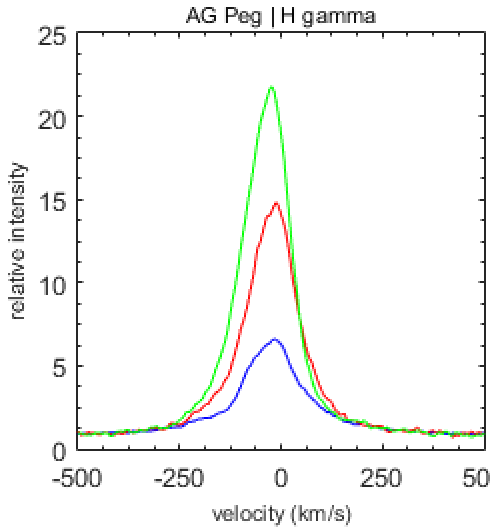
EShel spectra at R = 11000
01-07-2015 : O. Garde V = 7.0
29-07-2015 : F. Teyssier - V = 7.4
28-08-2015 : F. Teyssier - V = 7.7

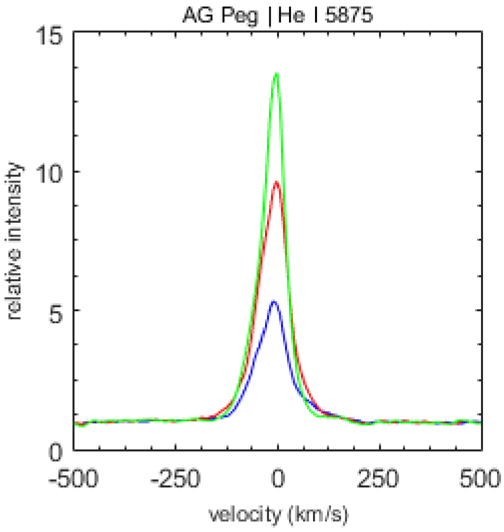
The spectra are corrected for helio-centric velocity

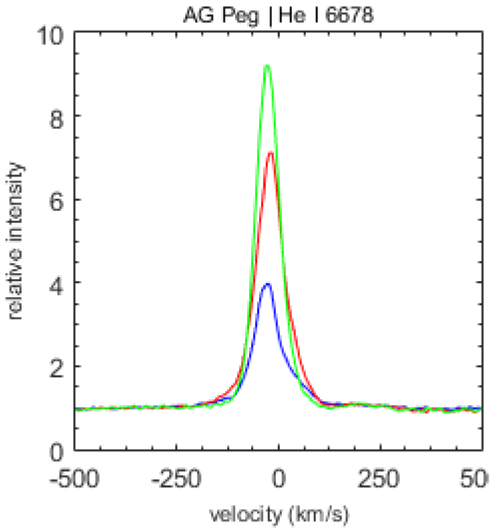


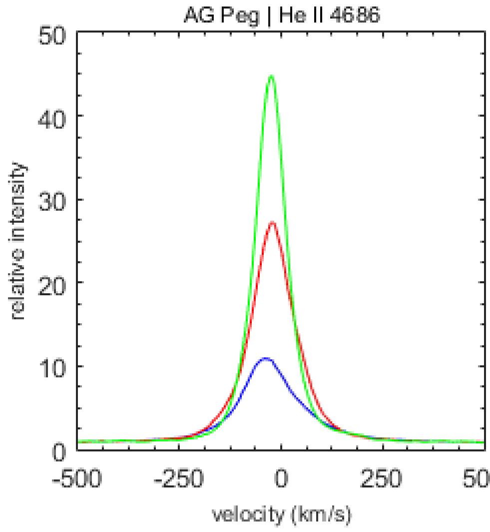




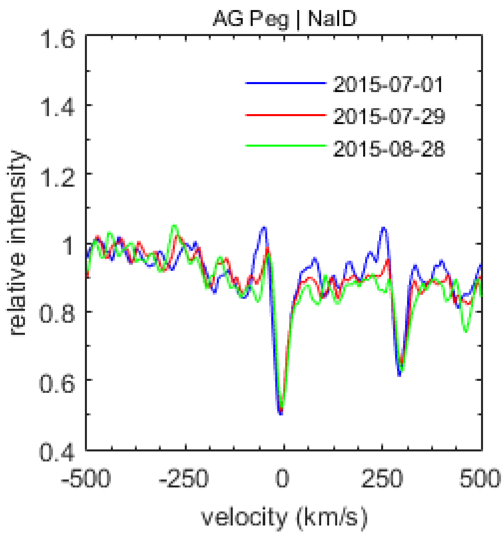


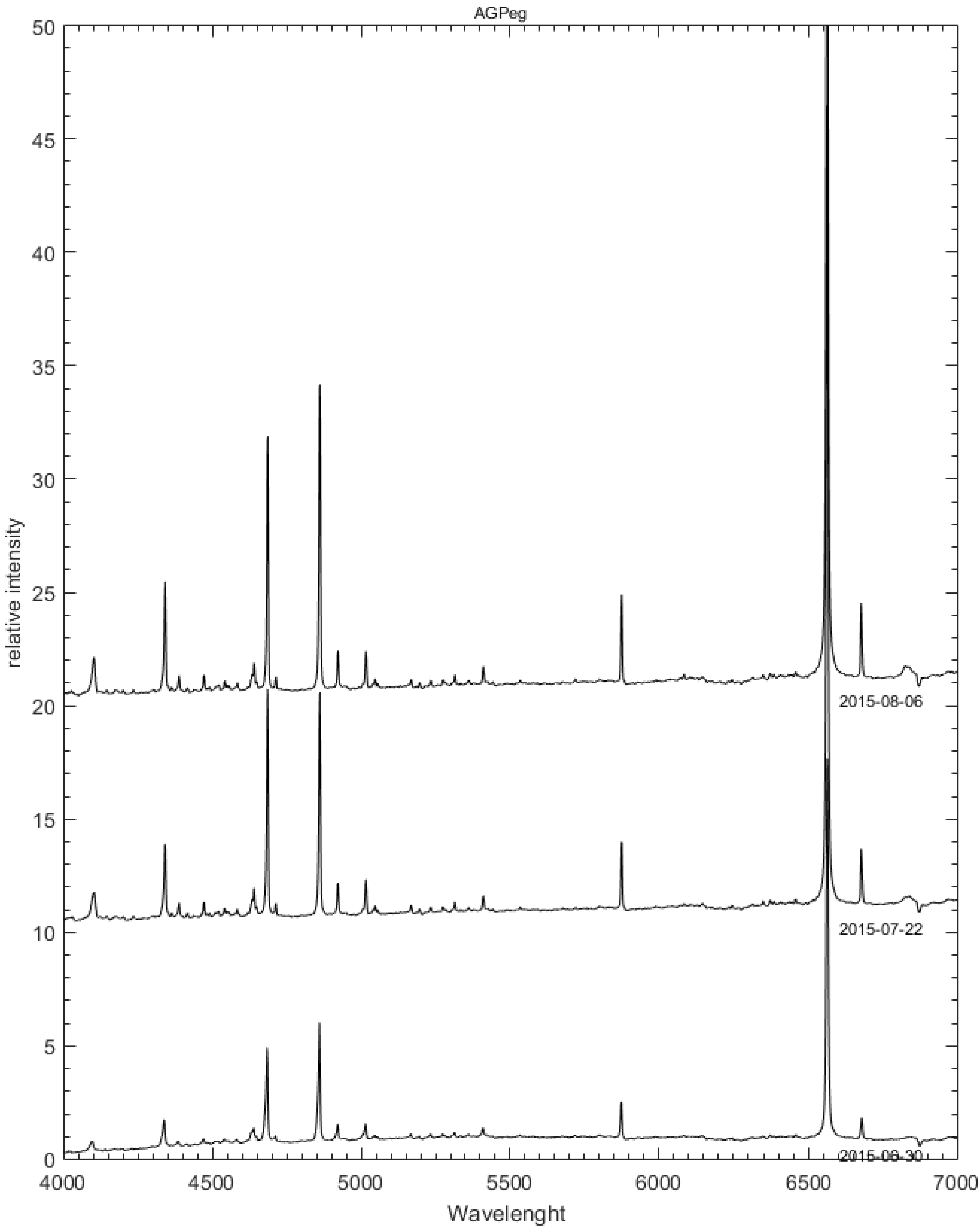






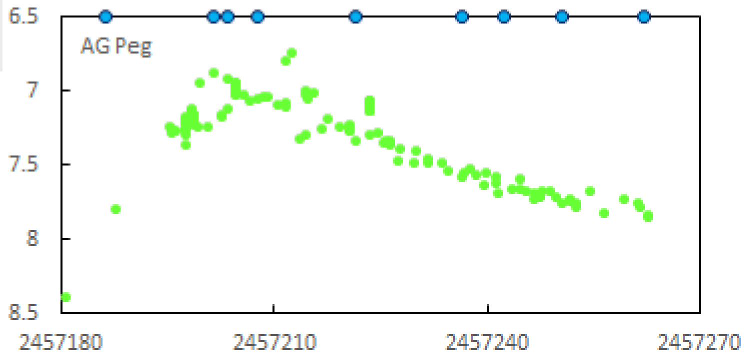
Interstellar Na I D
Check of wavelenght calibration

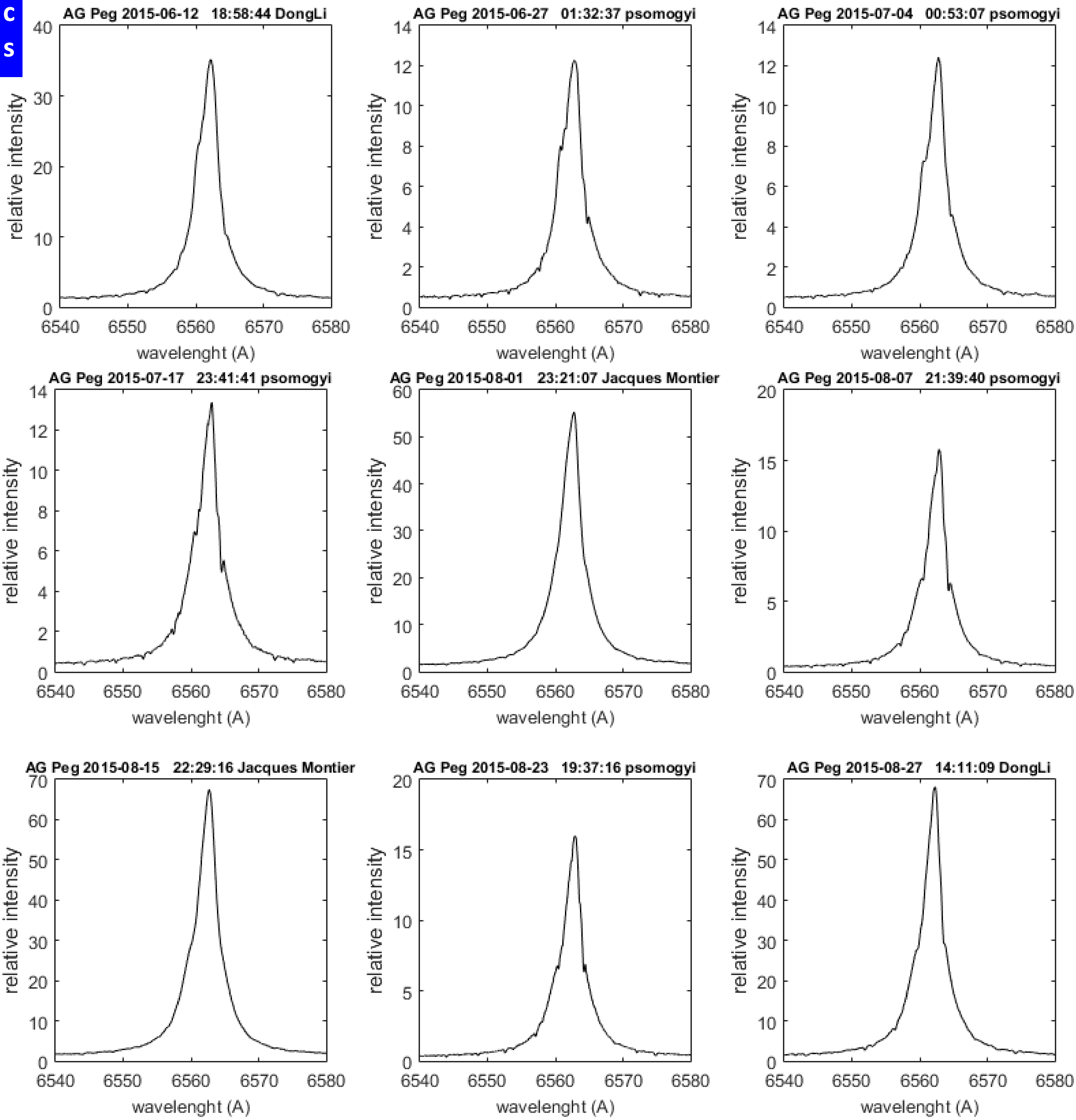



AGPeg
relative intensity
Wavelenght
2015-08-06
2015-07-22
2015-06-30
0
5
10
15
20
25
30
35
40
45
50
4000
4500
5000
5500
6000
6500
7000

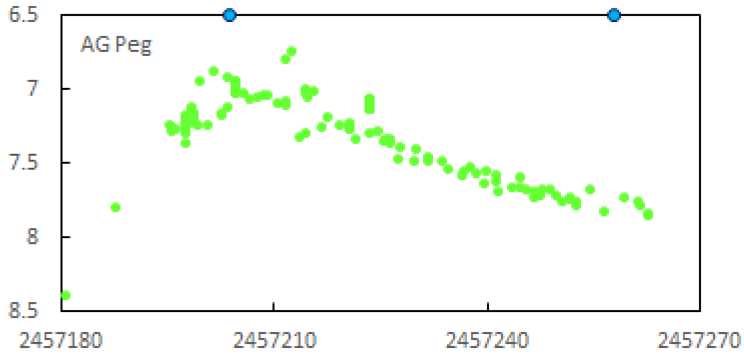
AG Peg : evolution of Hα at R ~1 000

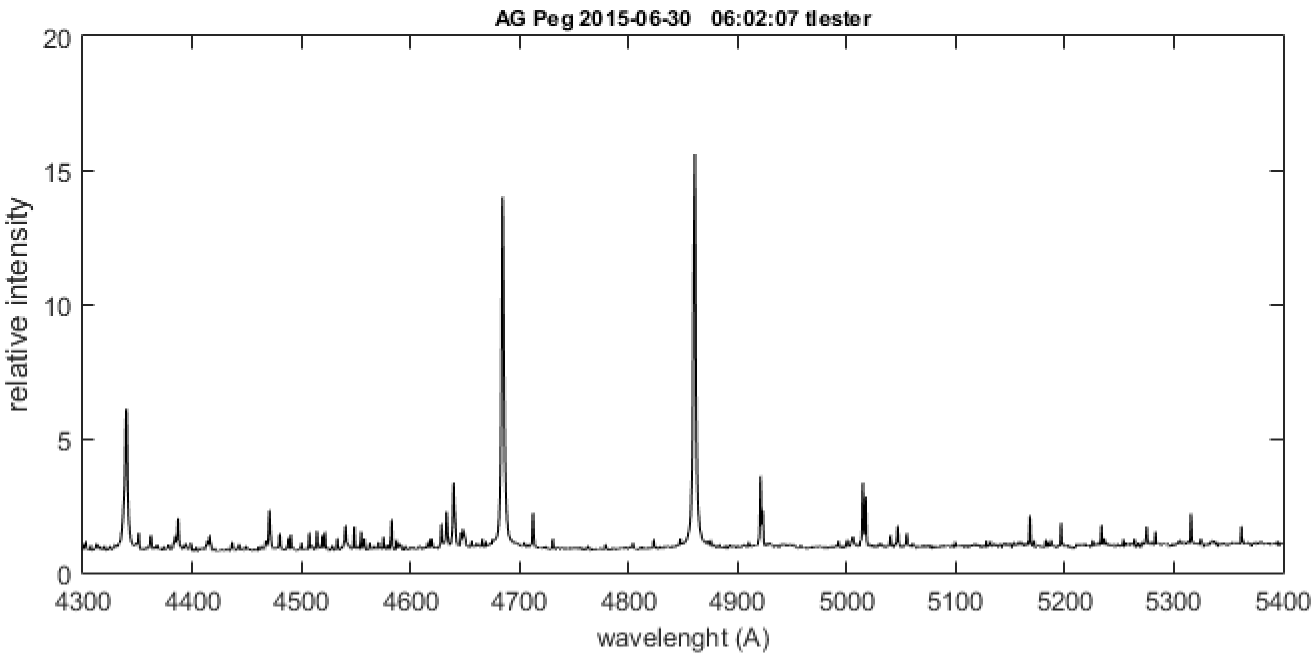
H alpha profile during the outburst at R ~ 15000 (Lhires III - 2400 l/mm
Dong Li, Peter Somogyi, Jacques Montier

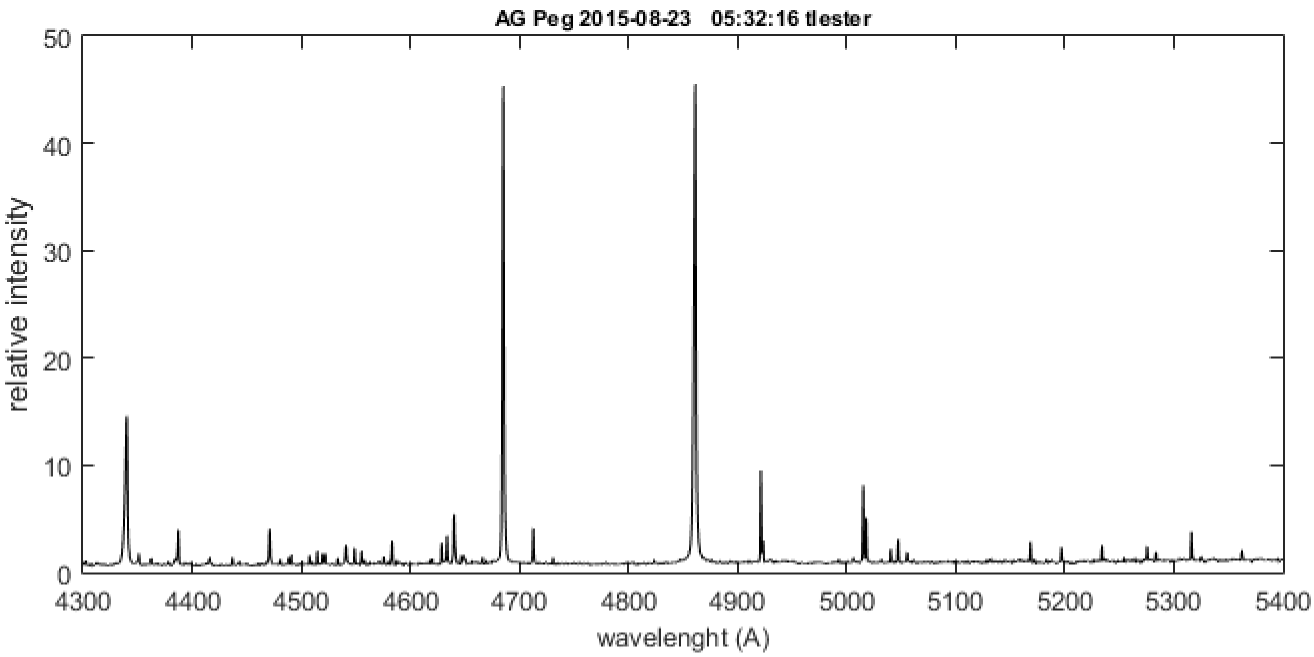




The Hb region by Tim Lester at R ~ 6000 with a home built spectrographe

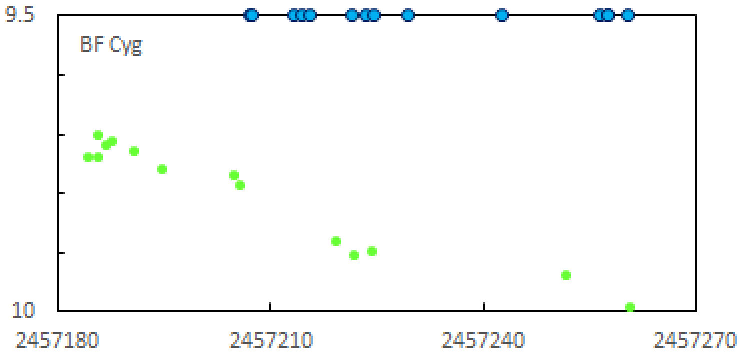




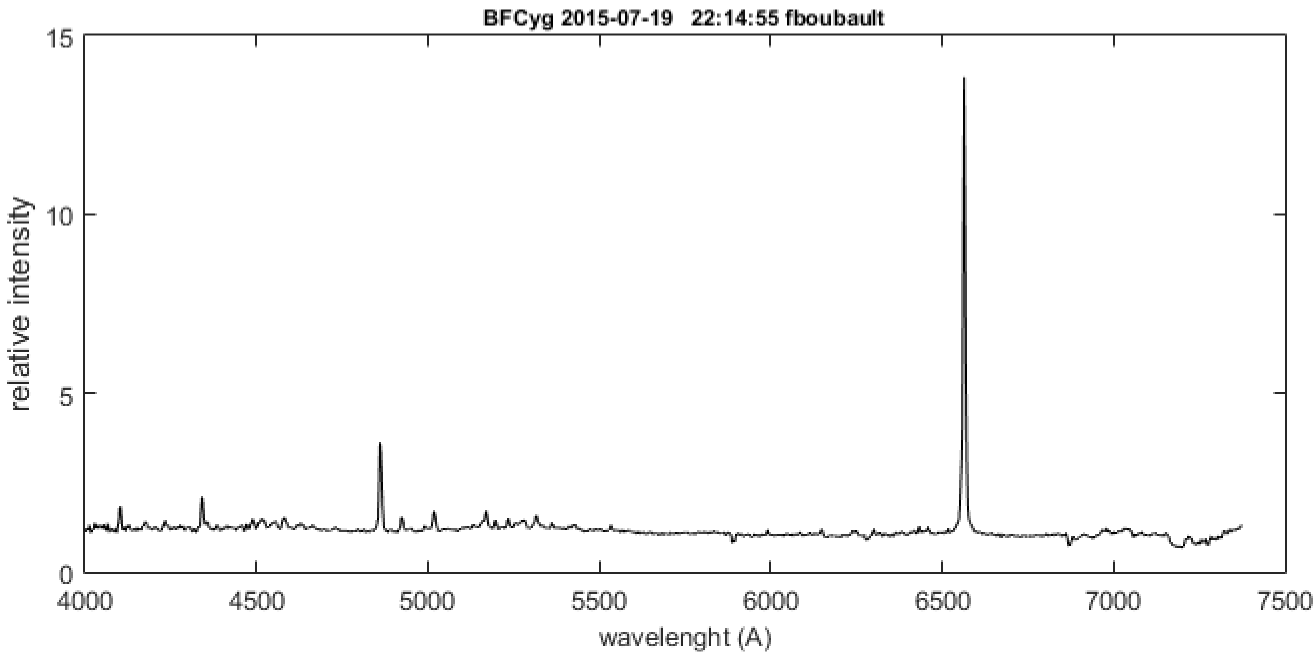


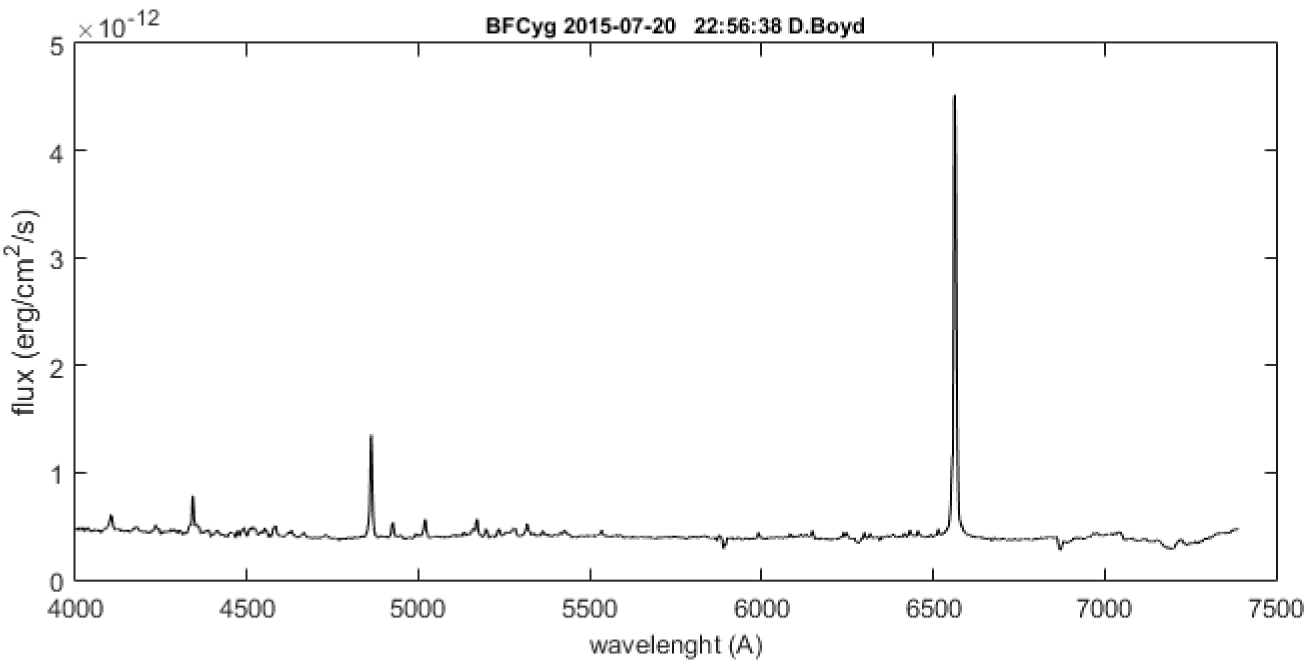
BF Cygni

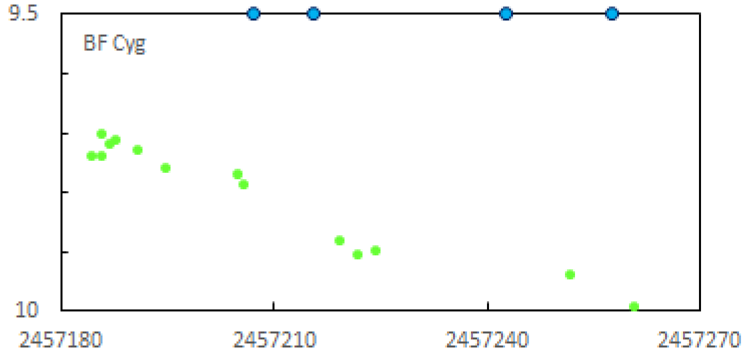
Coordinates (2000.0)	
R.A.	19 23 53.5
Dec.	+29 40 29.2

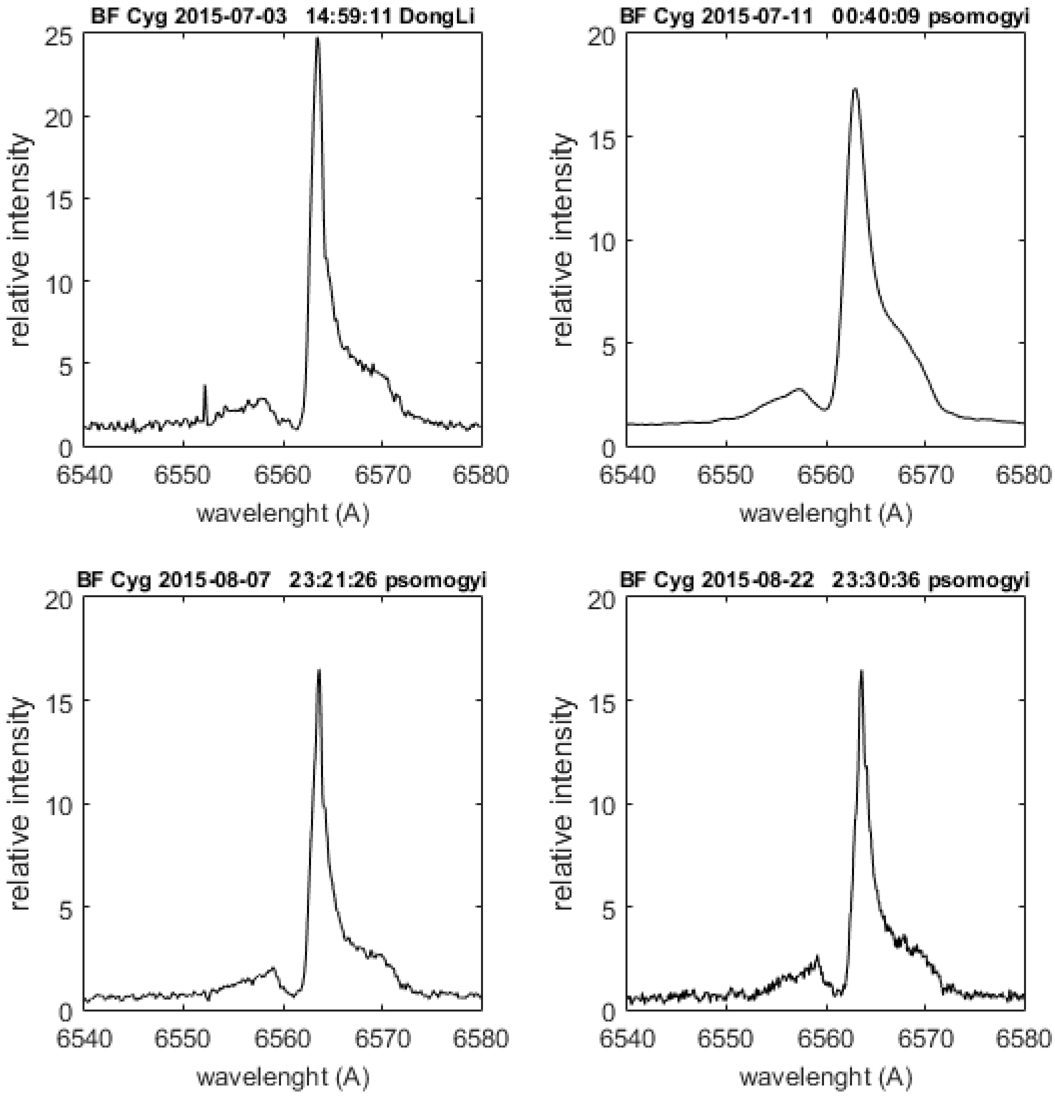


Slowly declining
The hump in the red part of H alpha remains strong
Changes in the blue absorption



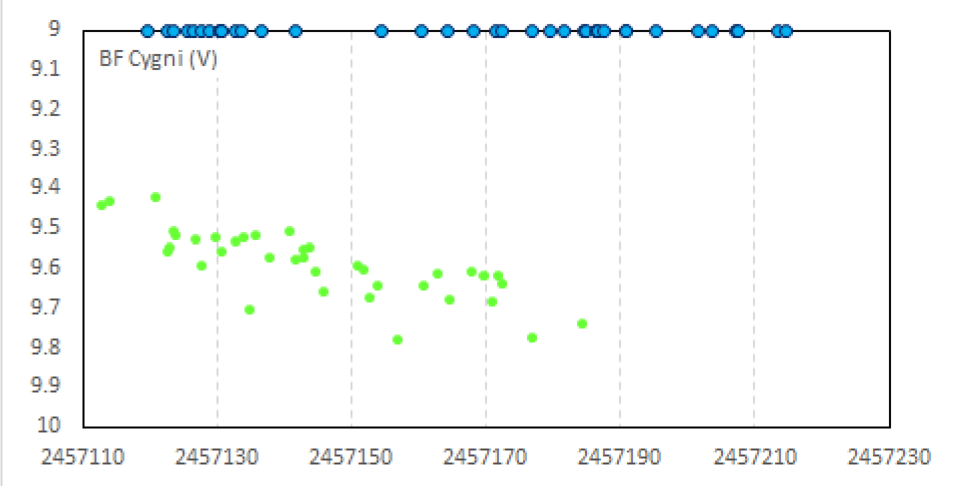


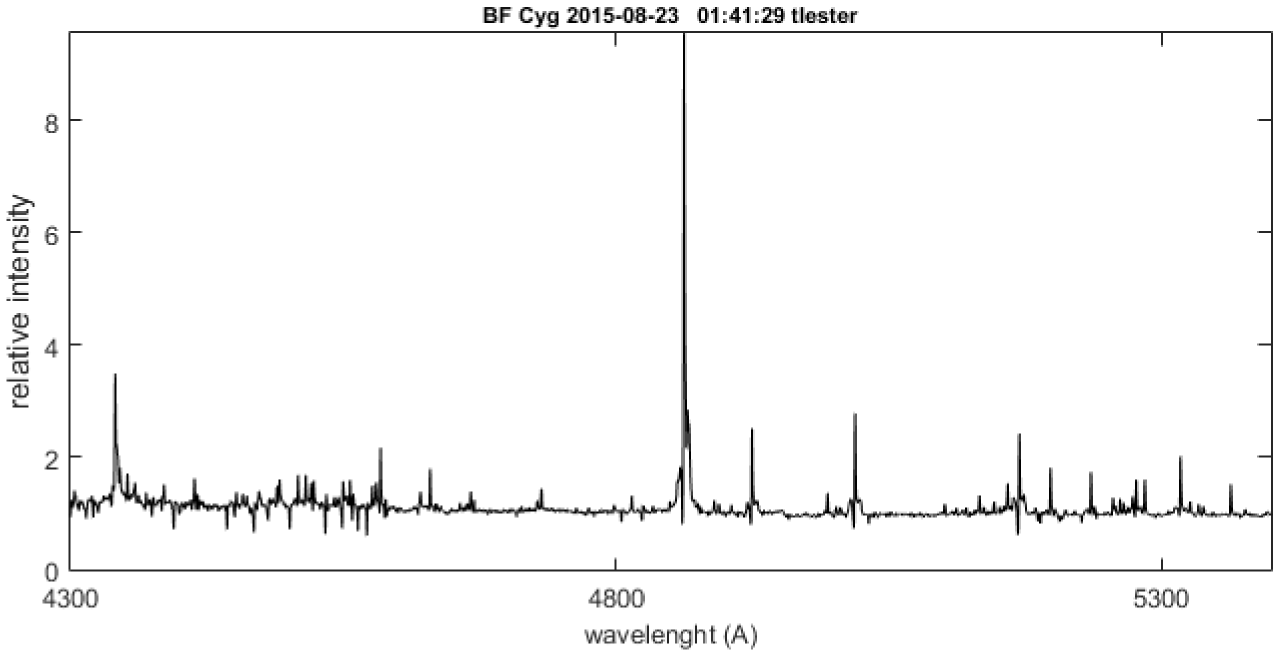

9.5
BF Cyg
10
2457180
2457210
2457240
2457270

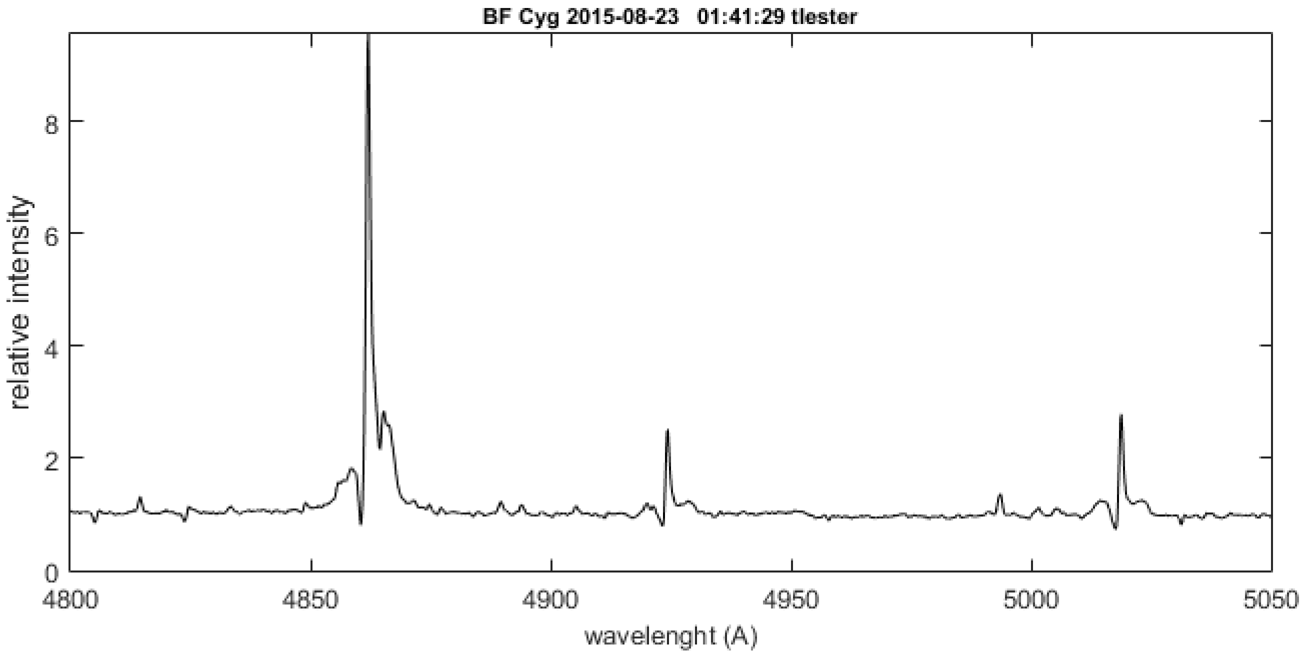

BF Cyg 2015-07-03 14:59:11 DongLi
BF Cyg 2015-07-11 00:40:09 psomogyi
BF Cyg 2015-08-07 23:21:26 psomogyi
BF Cyg 2015-08-22 23:30:36 psomogyi
relative intensity
wavelenght (A)
6540
6550
6560
6570
6580
0
5
10
15
20
25

BF Cygni

Coordinates (2000.0)	
R.A.	19 23 53.5
Dec.	+29 40 29.2







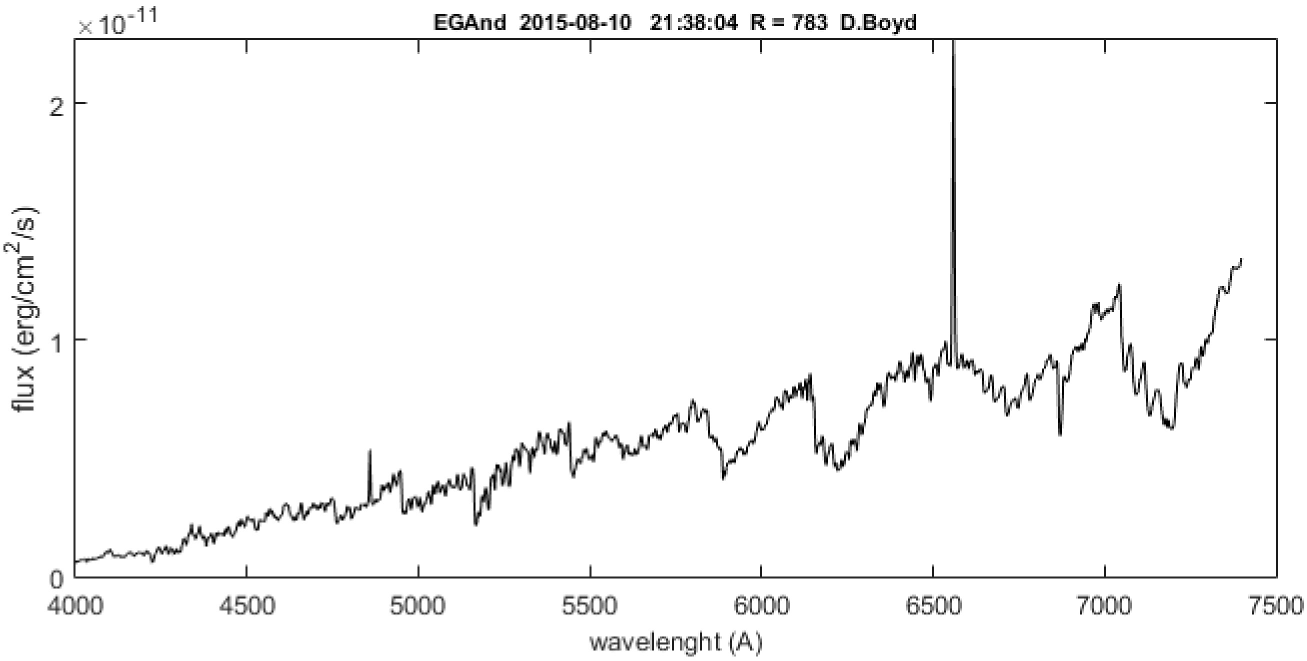
Crop on Hβ, Fe II (42) 4924, 5018

EG And

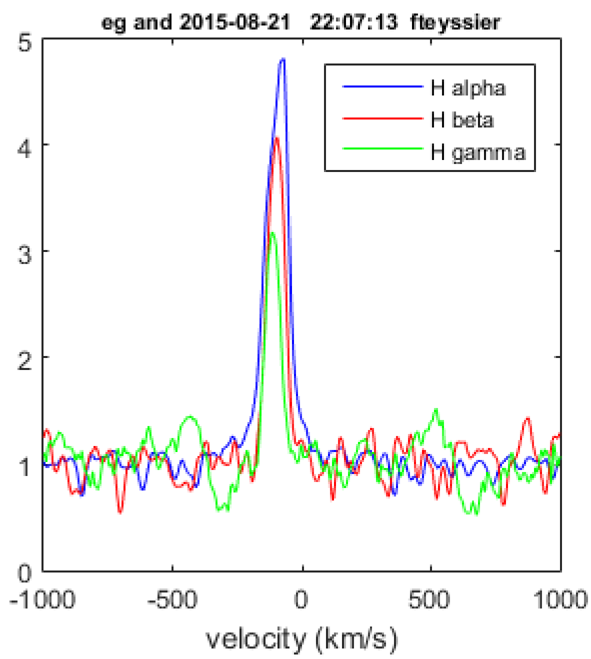
Coordinates (2000.0)	
R.A.	00 44 3701
Dec.	+40 40 45.7
Mag	7.0 - 7.4

EG And is bright,eclipsing, symbiotic star.

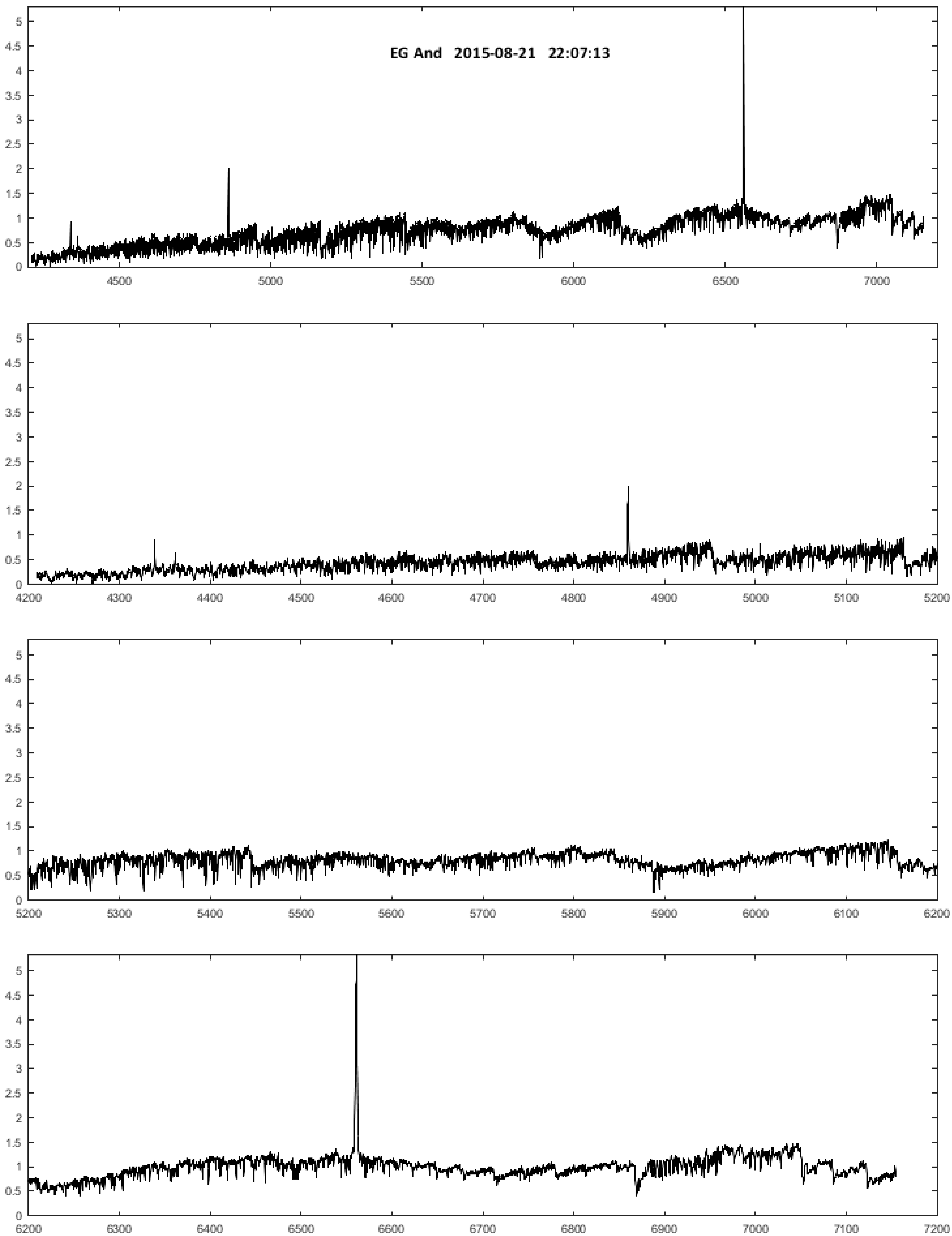
Orbital period	485.6 d	Fekel & al. (2000)
Spectral type	M2.4III	Kenyon & Fernandez Castro (



Flux calibrated Spectrum obtained by D. Boyd with a LISA

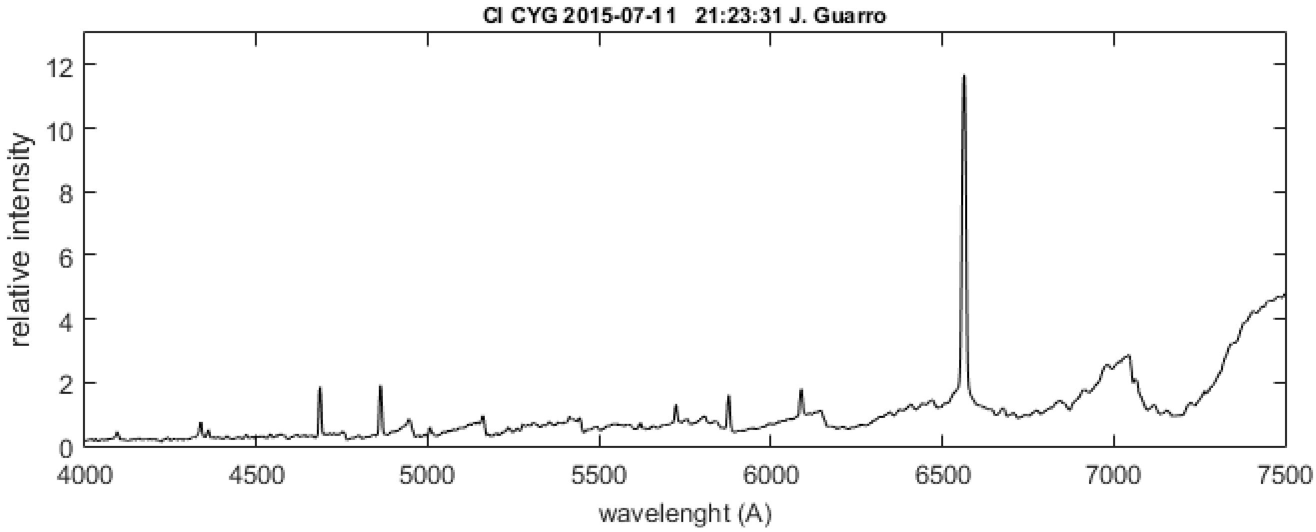


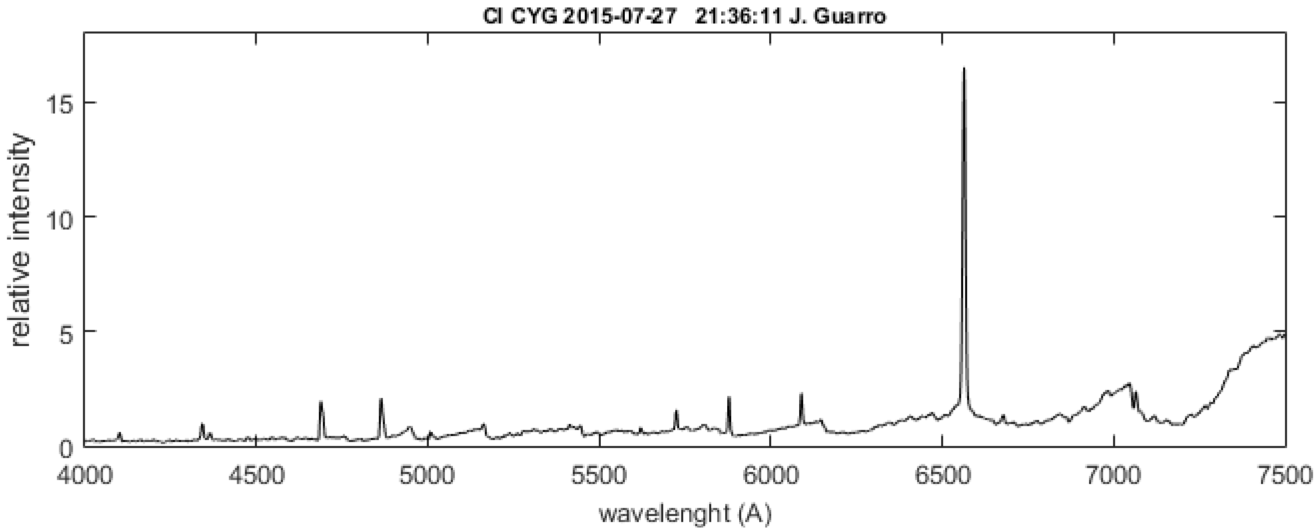
Hα , Hβ and Hγ lines in radial velocity
F. Teyssier - eShel
The FWHM is respectively 97, 79, 65 km.s-1
The radial velocity of Ha is -92 km.s-1

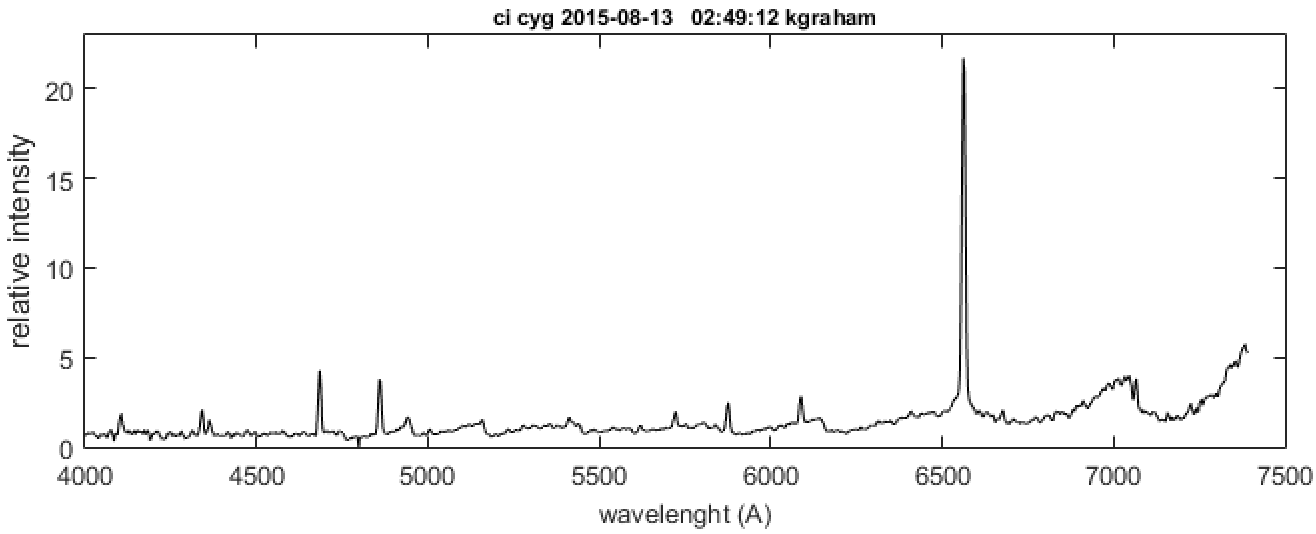

EG And 2015-08-21 22:07:13

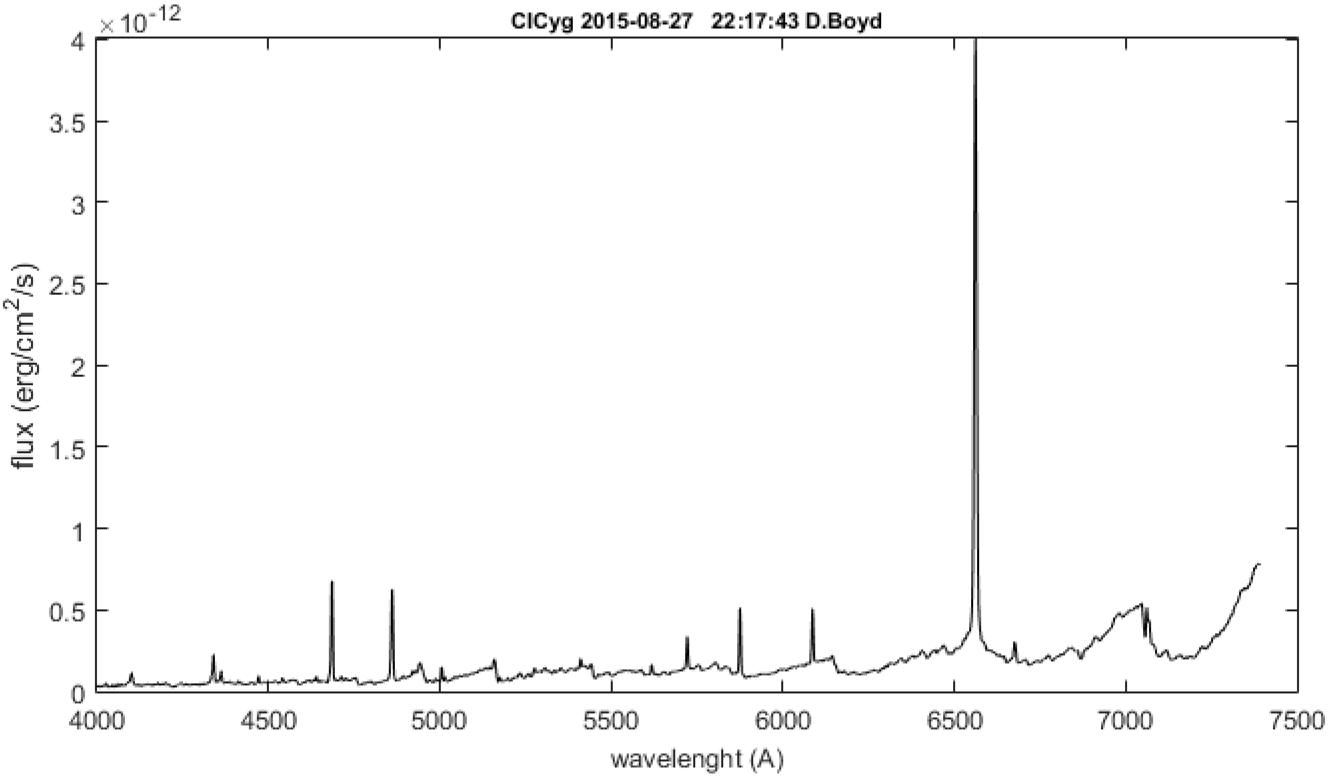
CI Cyg

Coordinates (2000.0)	
R.A.	19 50 11.8
Dec.	+35 41 03.0
Mag V	11

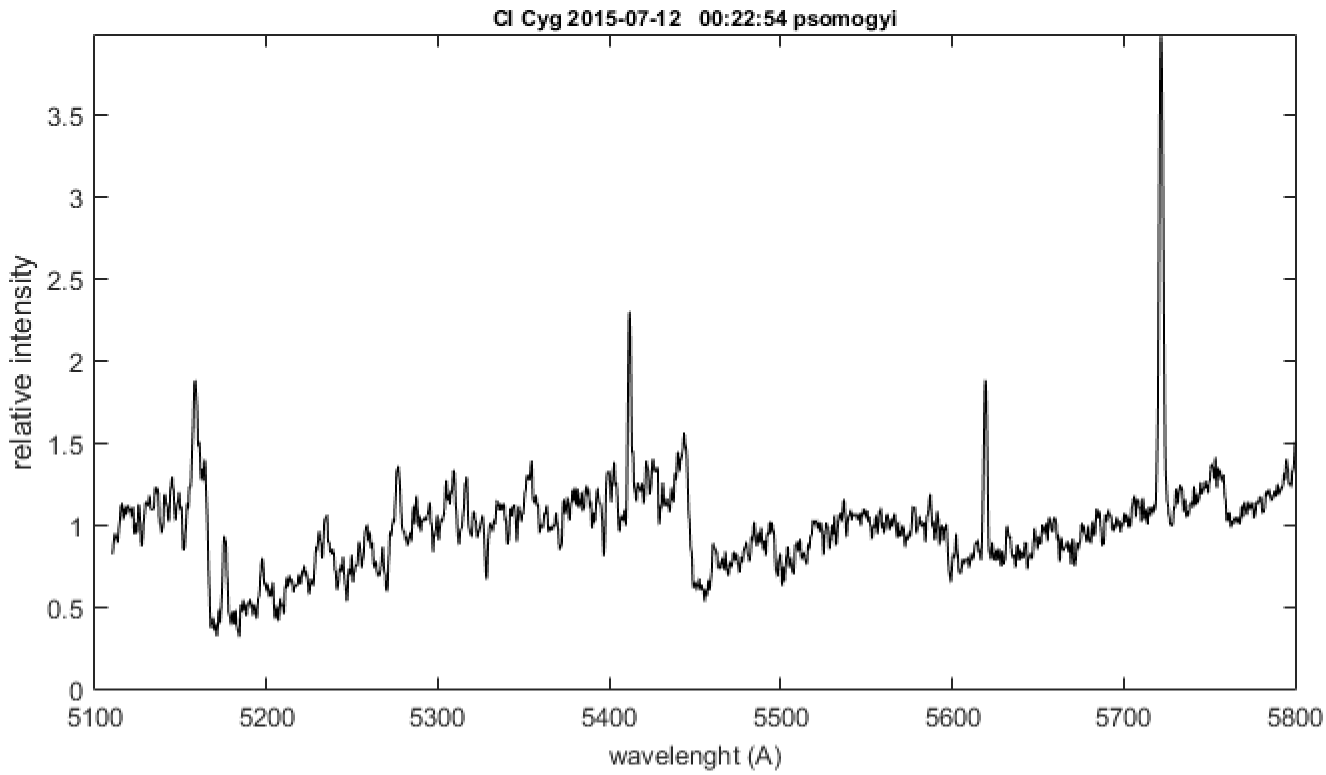








Flux calibrated spectrum - David Boyd - LISA R = 1000

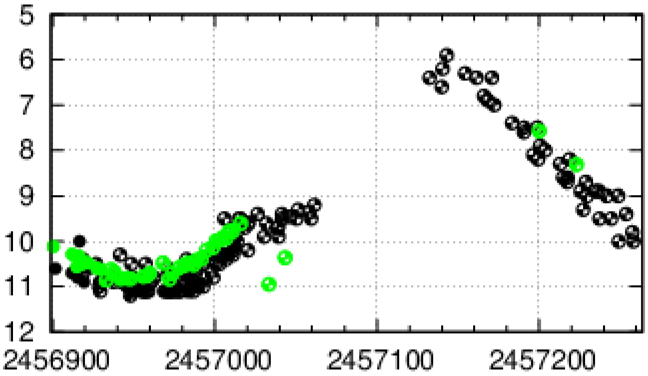


Green range with a Lhires III - 600 l/mm - R = 3500

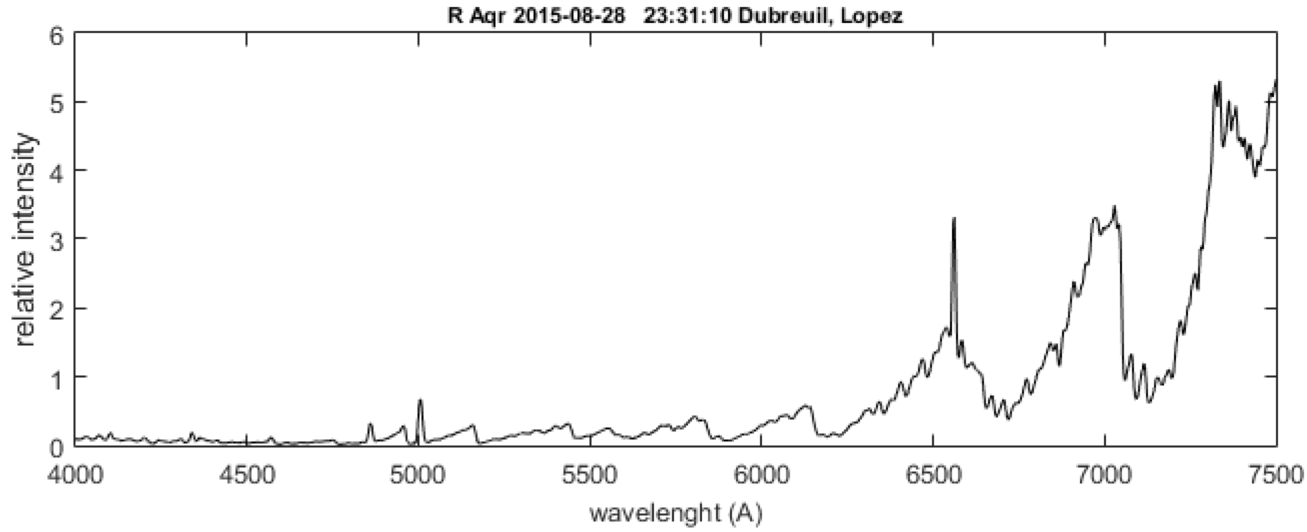
The main lines are [Fe VII] 5158 [Fe VI] 5176 [Fe VII] 5276 He II 5411 [Ca VII] 5619 [Fe VII] 5721

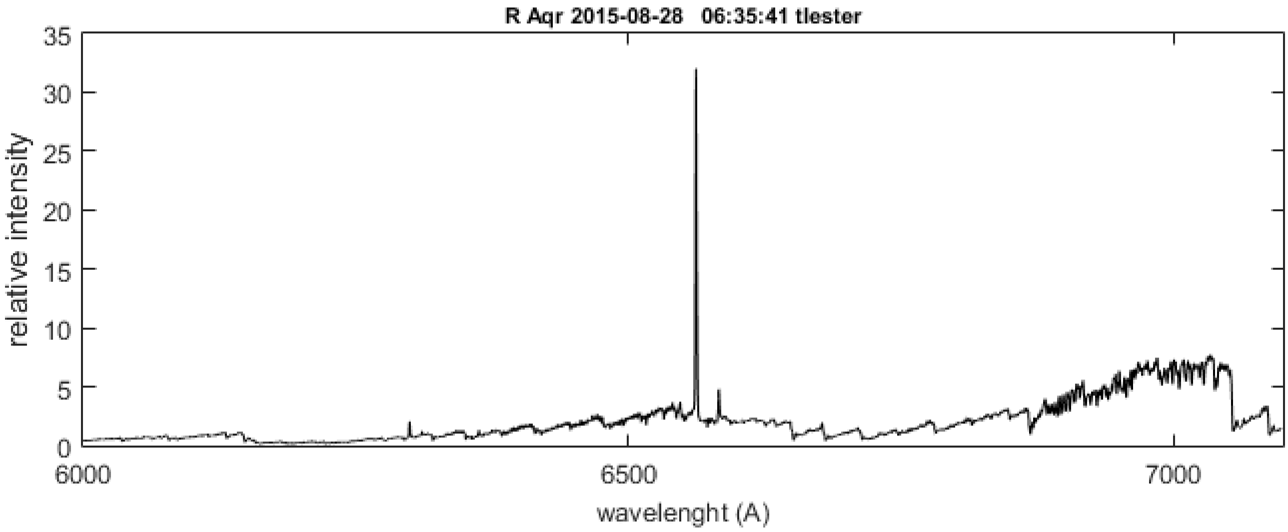
R AQr

Coordinates (2000.0)	
R.A.	23 43 49.4
Dec.	-15 17 04.1
Mag V	6 - 11

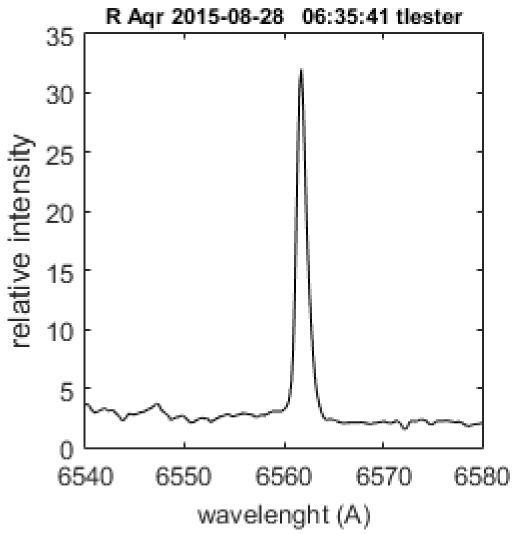


The symbiotic mira R Aqr near minimum luminosity
Note the strong [O III]
Other spectra around minimum are welcome





R Aqr at R = 9000
By Tim Lester

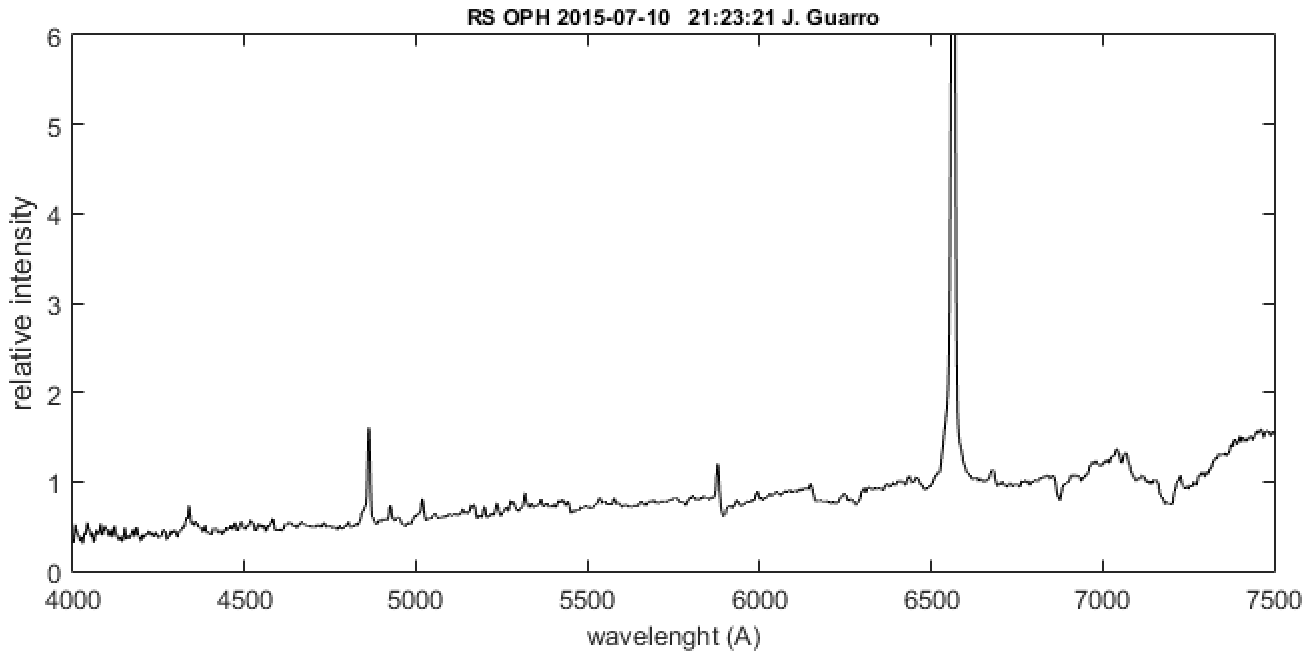


Astrophysics and geology

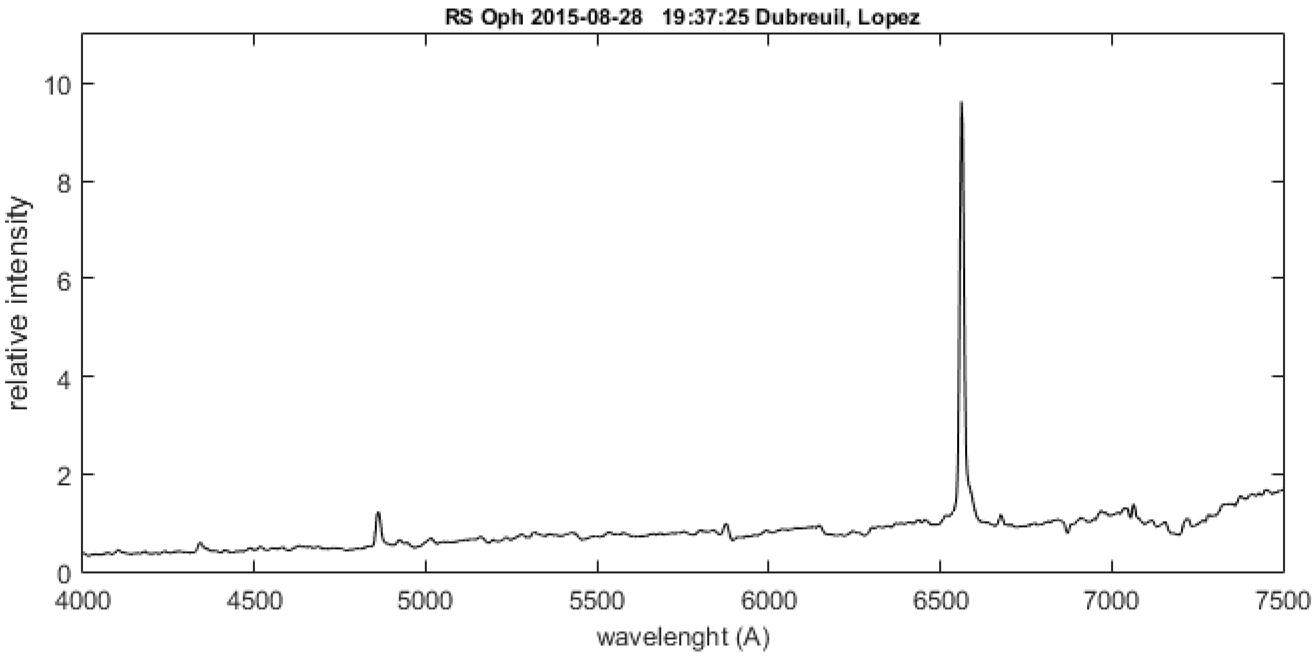
Symbiotic nova eruption of R Aquarii
A geological remnant?
Kenji Tanabe1
and Yuko Motizuki2
See
http://sait.oat.ts.astro.it/MmSAI/83/PDF/840.pdf

RS Oph

Coordinates (2000.0)	
R.A.	17 50 13.2
Dec.	-06 42 28
Mag V	



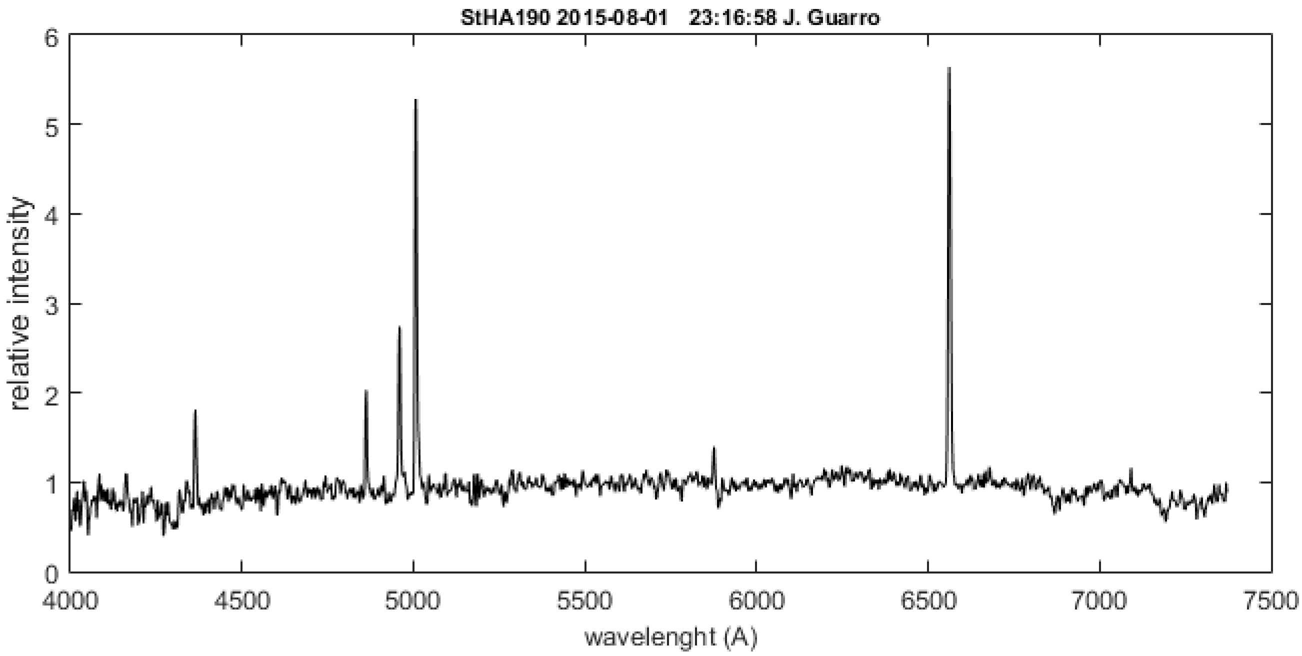
Home built spectrograph R = 900

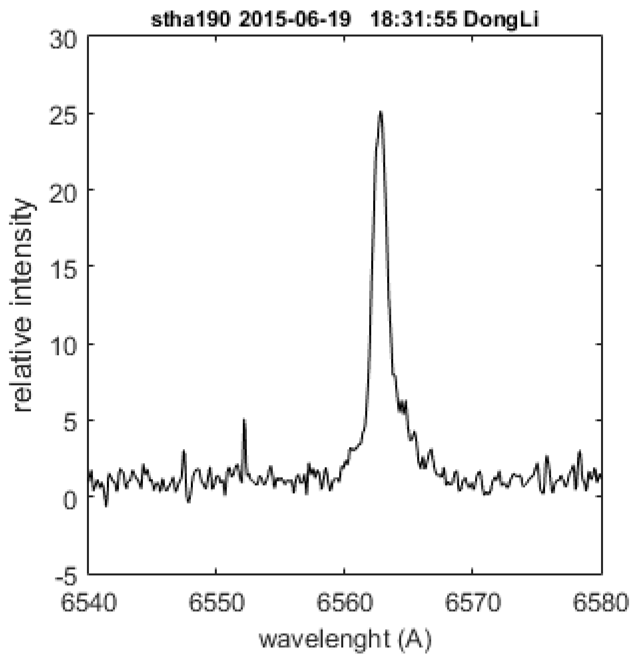


ALPY 600 R = 600

StHa 190

Coordinates (2000.0)	
R.A.	
Dec.	
Mag	~ 10.5

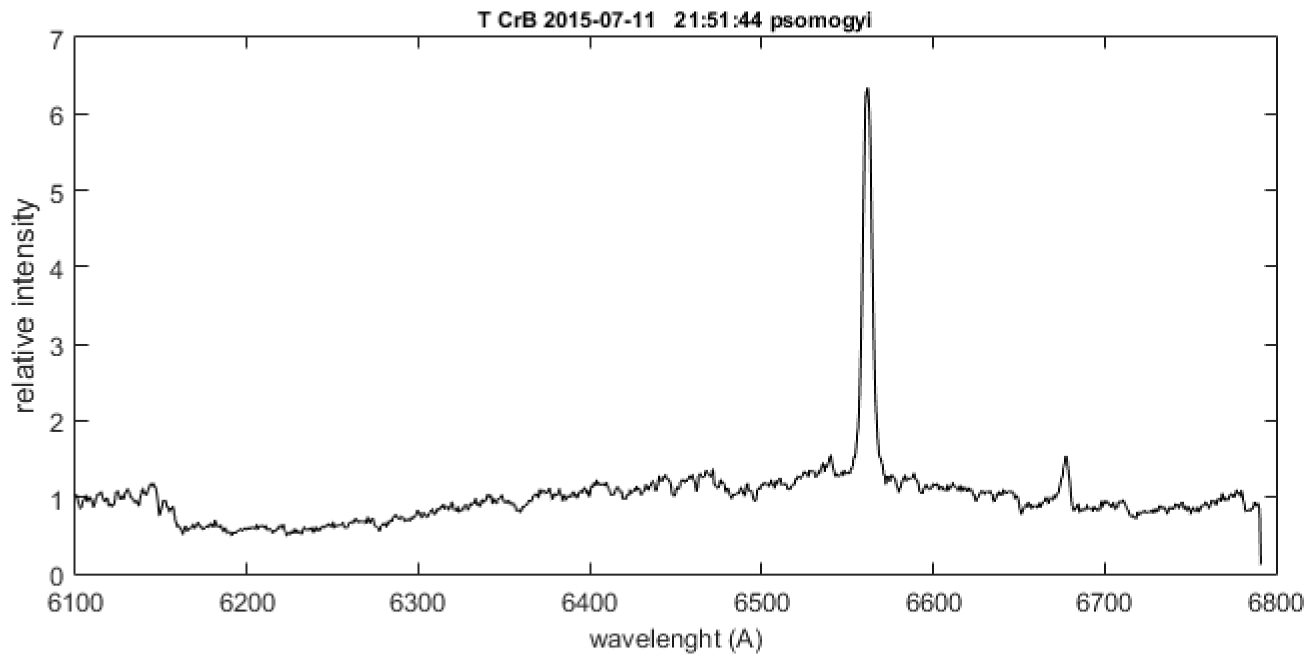


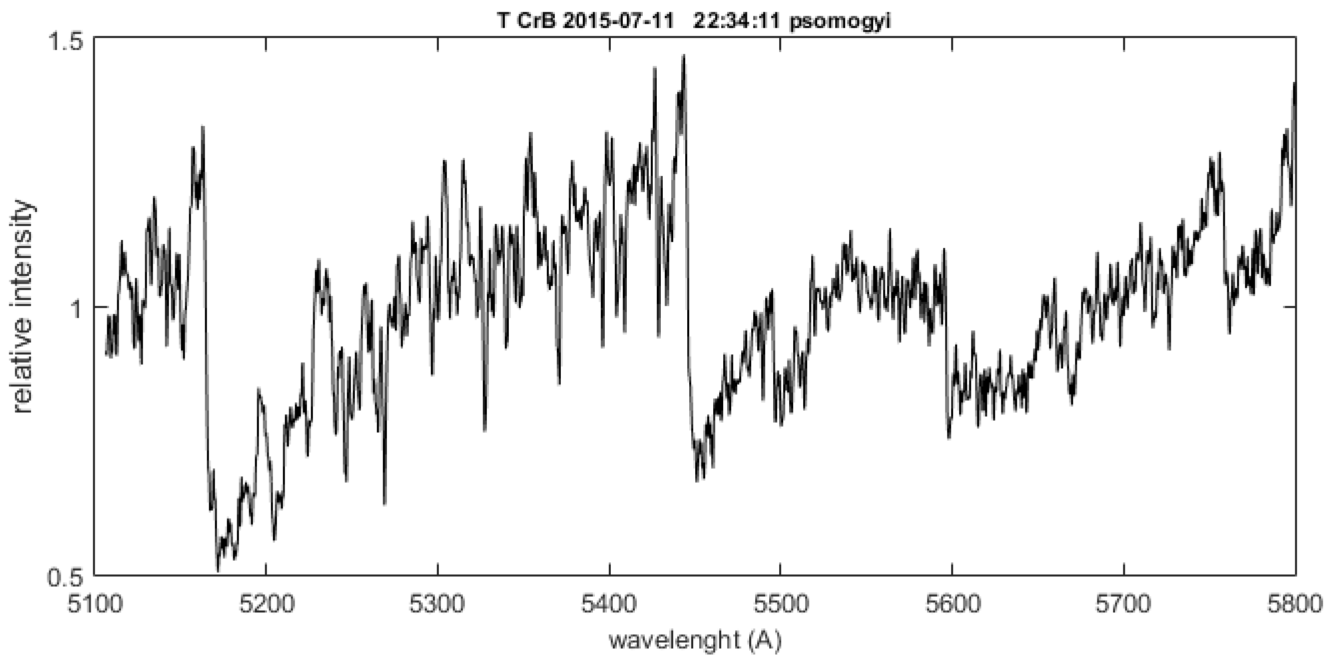


H alpha line by Dong Li
Lhires III 2400 l/mm
R = 12000

Coordinates (2000.0)	
R.A.	15 59 30.16
Dec.	+25 55 12.6
Mag	10.2

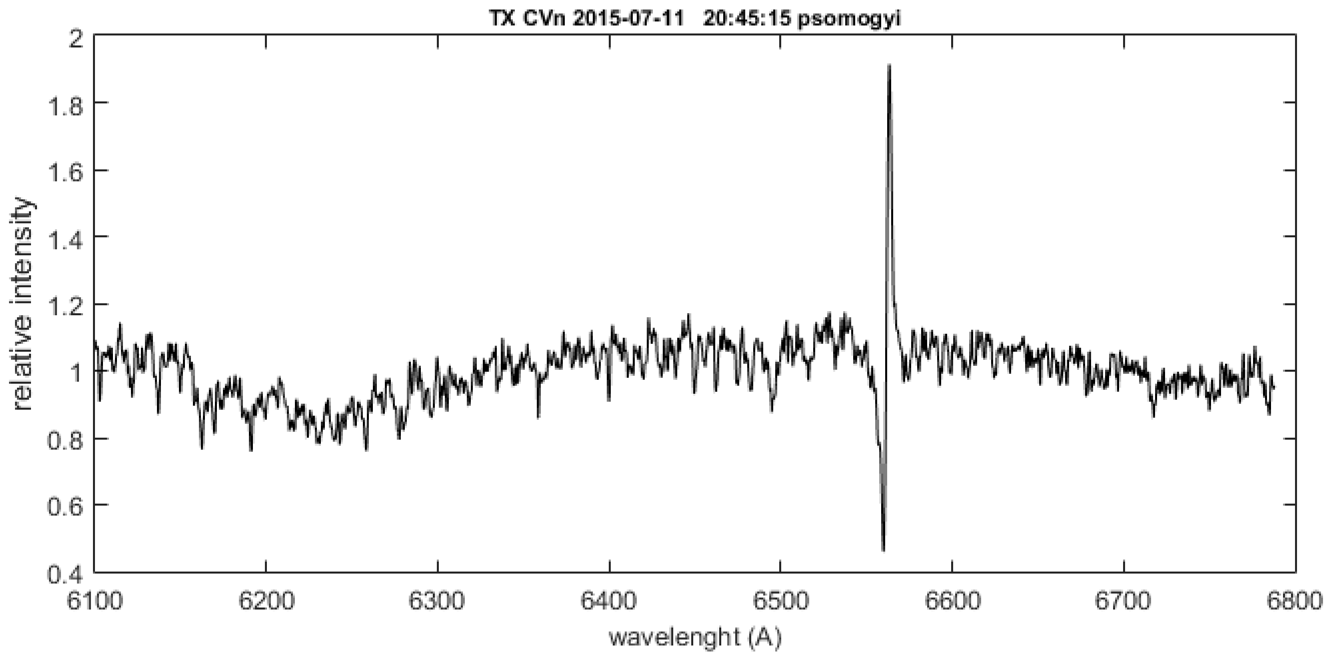
Lhires III 600 l/mm R = 3500





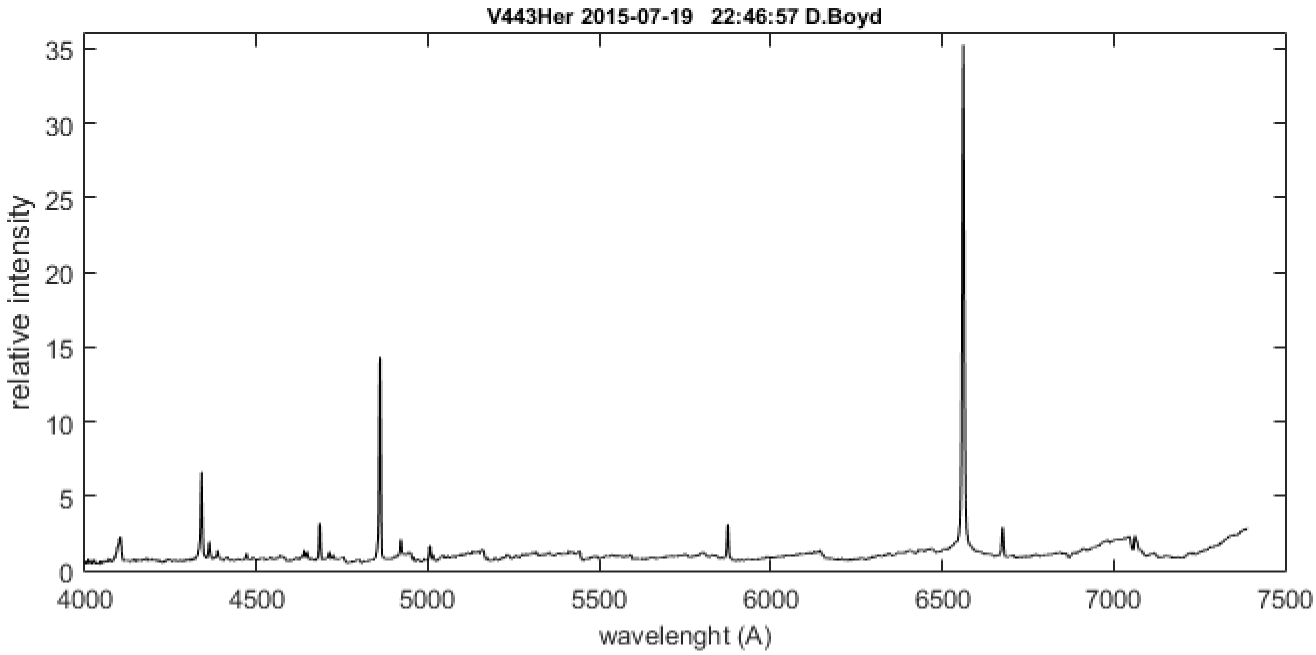
TX CVn

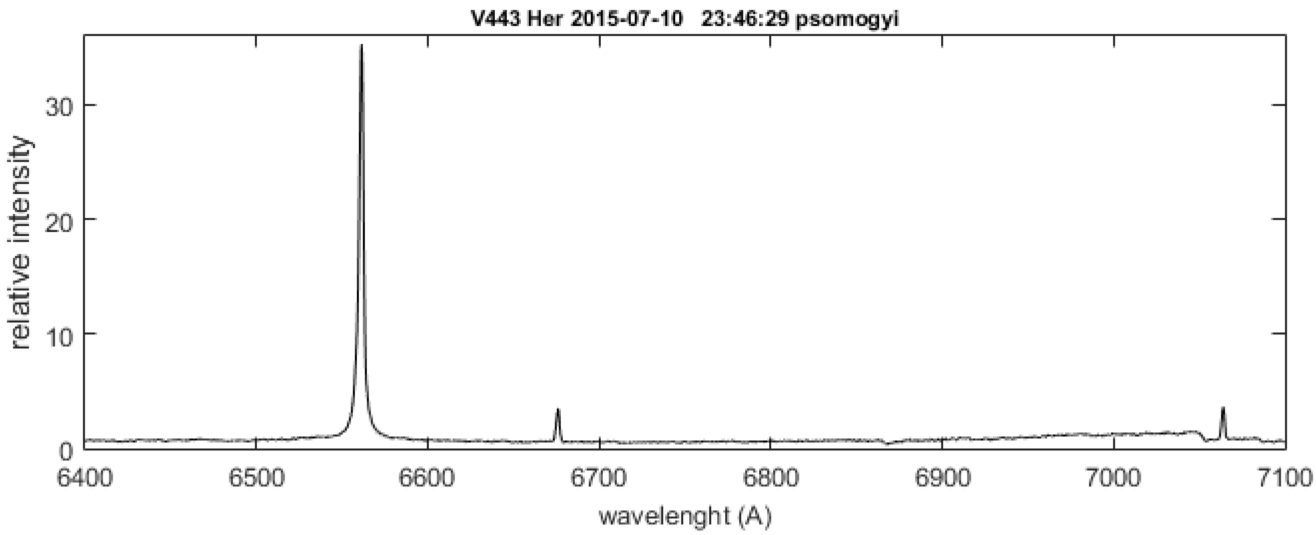
Coordinates (2000.0)	
R.A.	12 44 42.0
Dec.	+36 45 50.6
Mag V	9.8



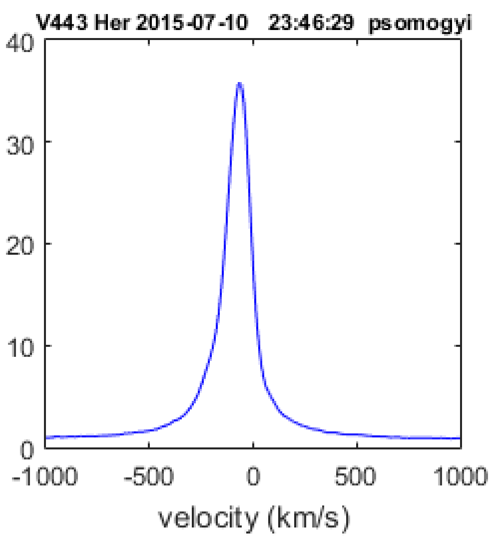
V443 Her

Coordinates (2000.0)	
R.A.	18 22 08.4
Dec.	+23 27 20.0
Mag V	~11.4



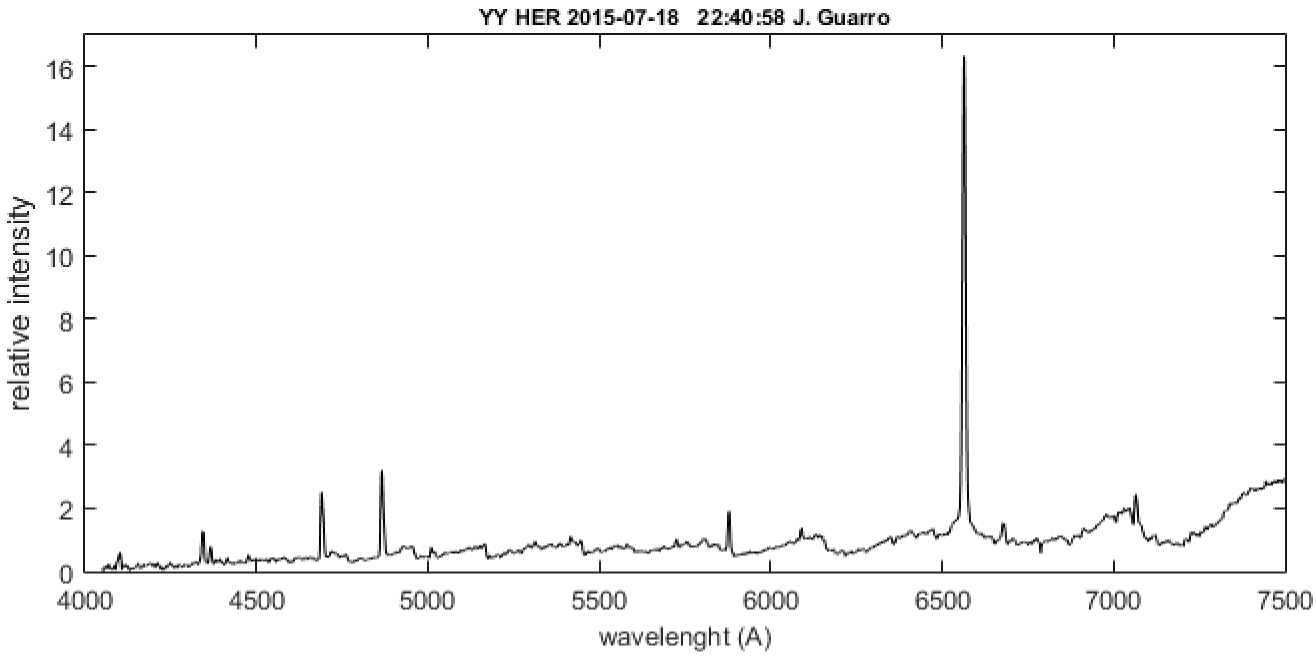


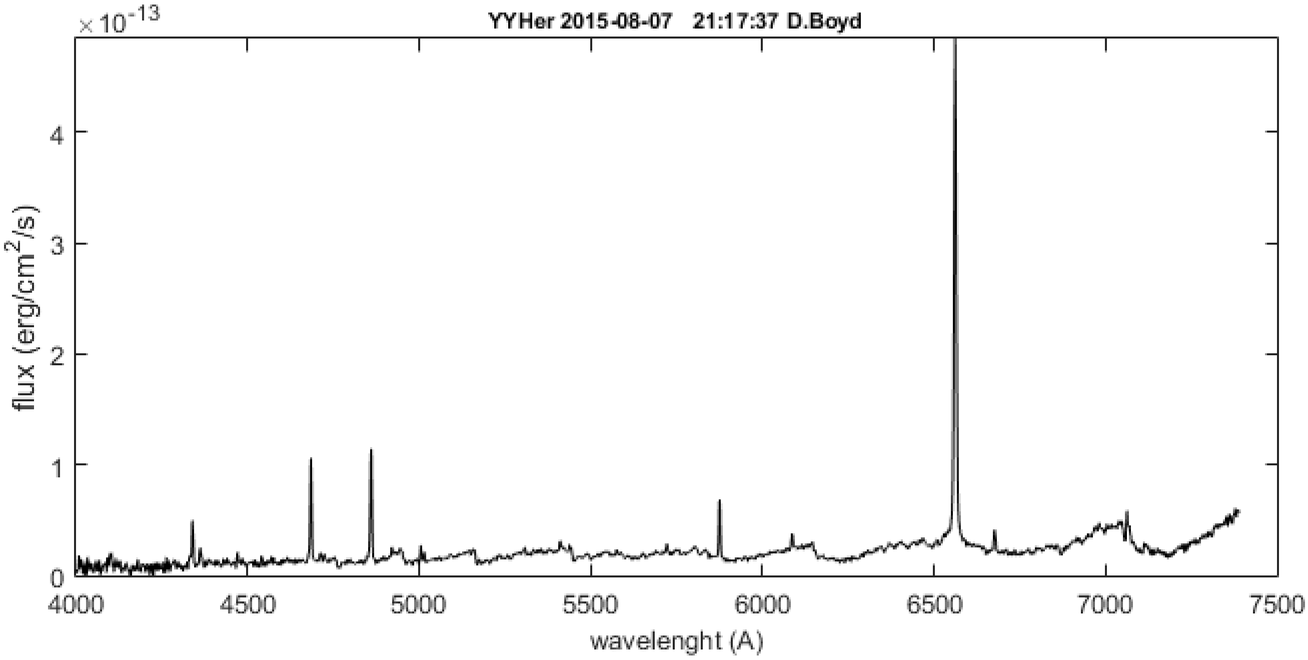
V443 Her
H alpha line at R = 3100
Lhires III 600 l/mm
P. Somogyi



YY Her

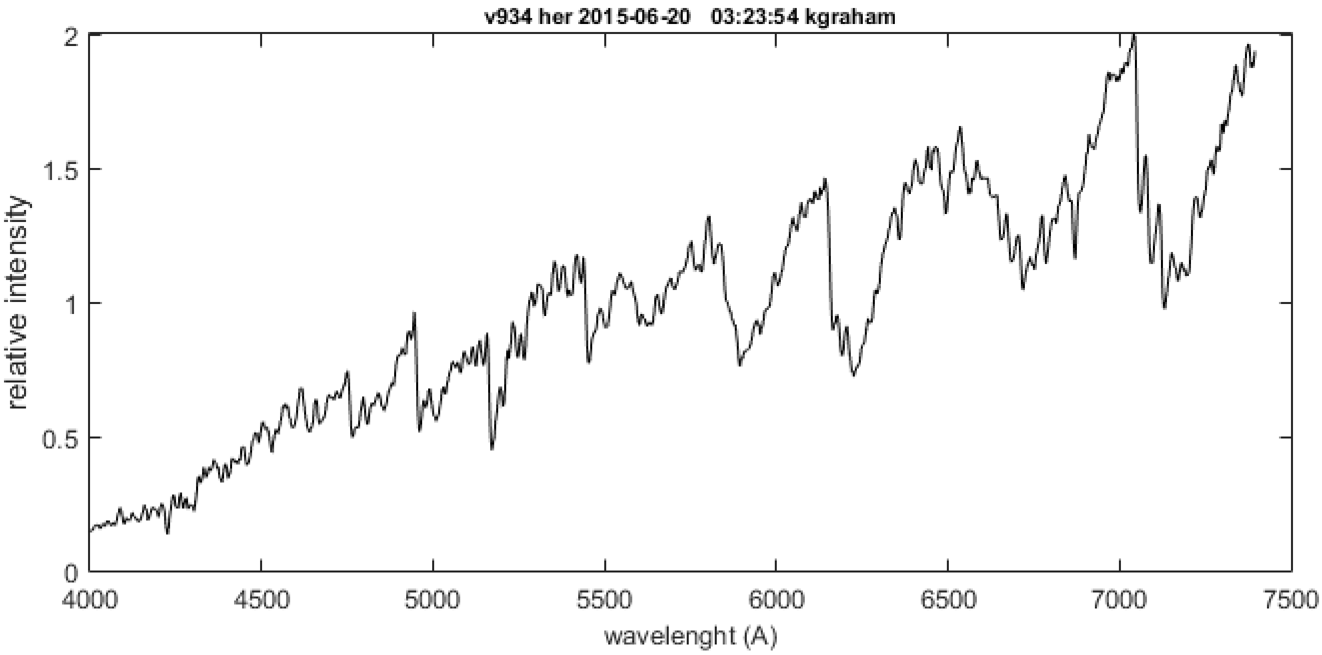
Coordinates (2000.0)	
R.A.	18 14 34.2
Dec.	+20 59 21.3
Mag V	12.8



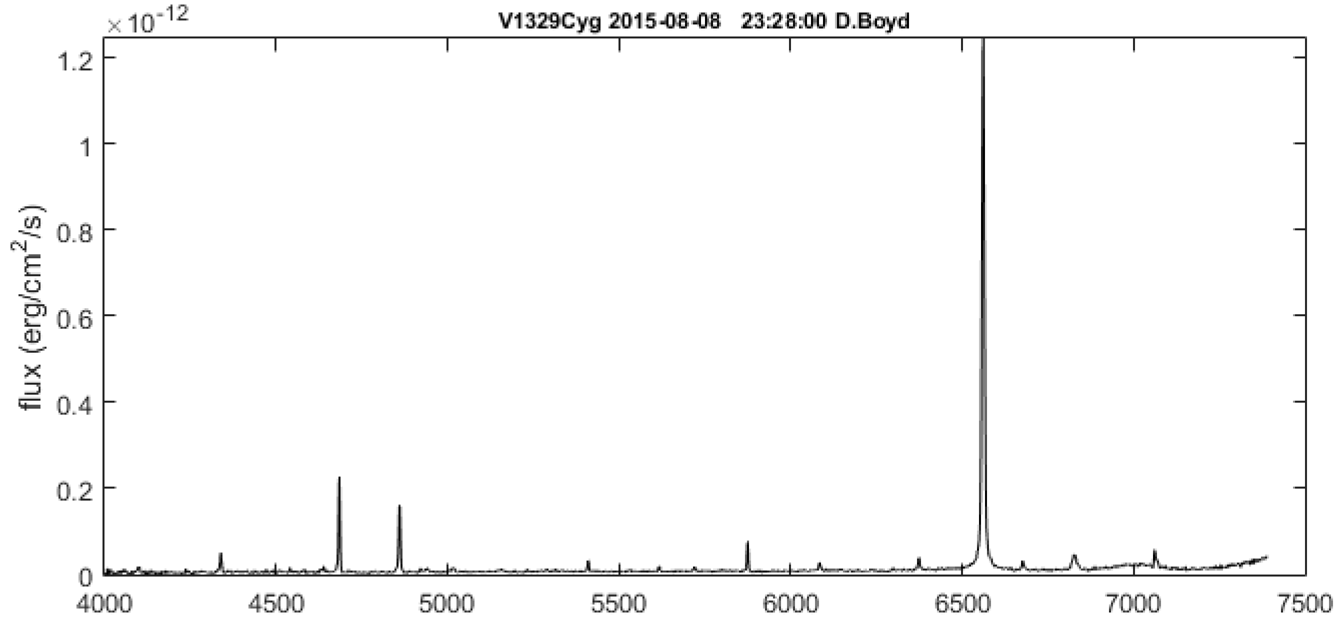


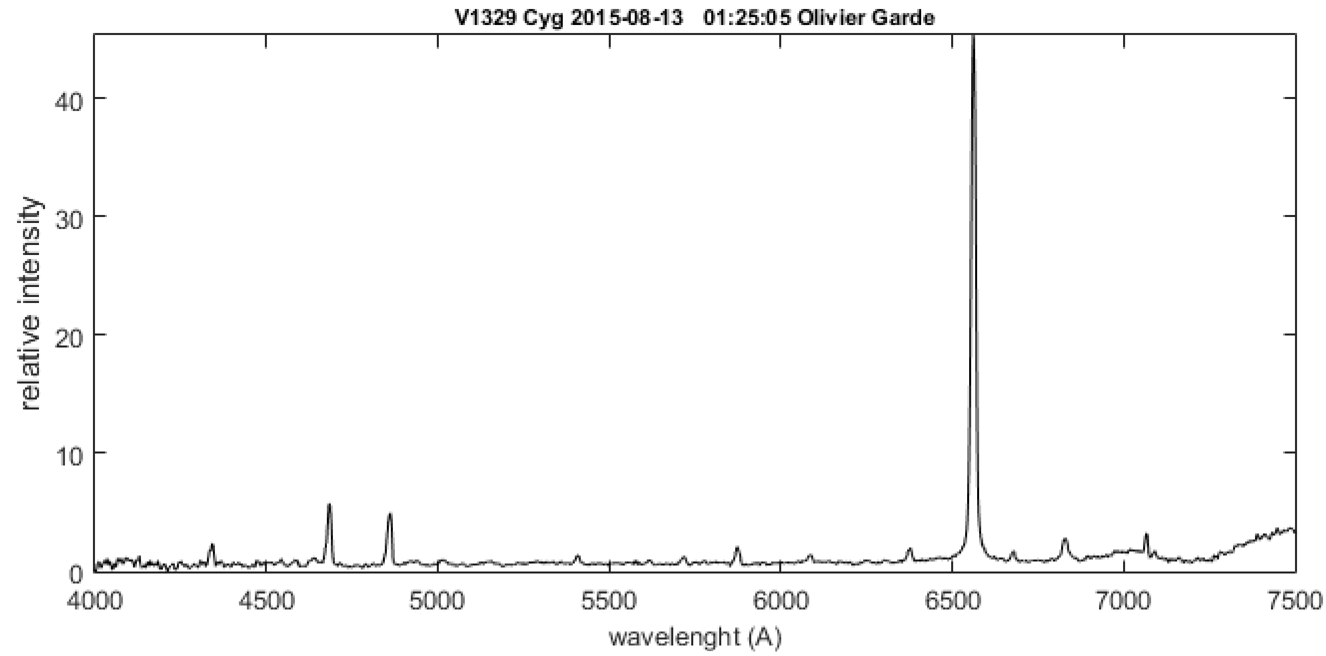
V934 Her

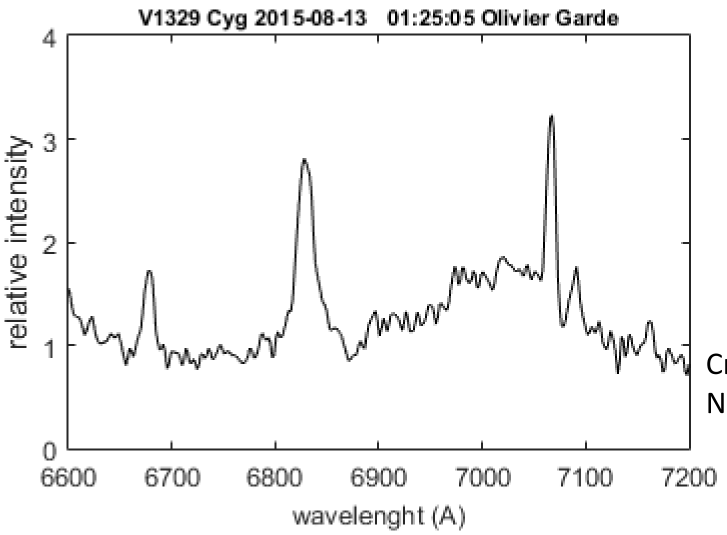
Coordinates (2000.0)
R.A.
Dec.
Mag V



Coordinates (2000.0)	
R.A.	
Dec.	
Mag V	

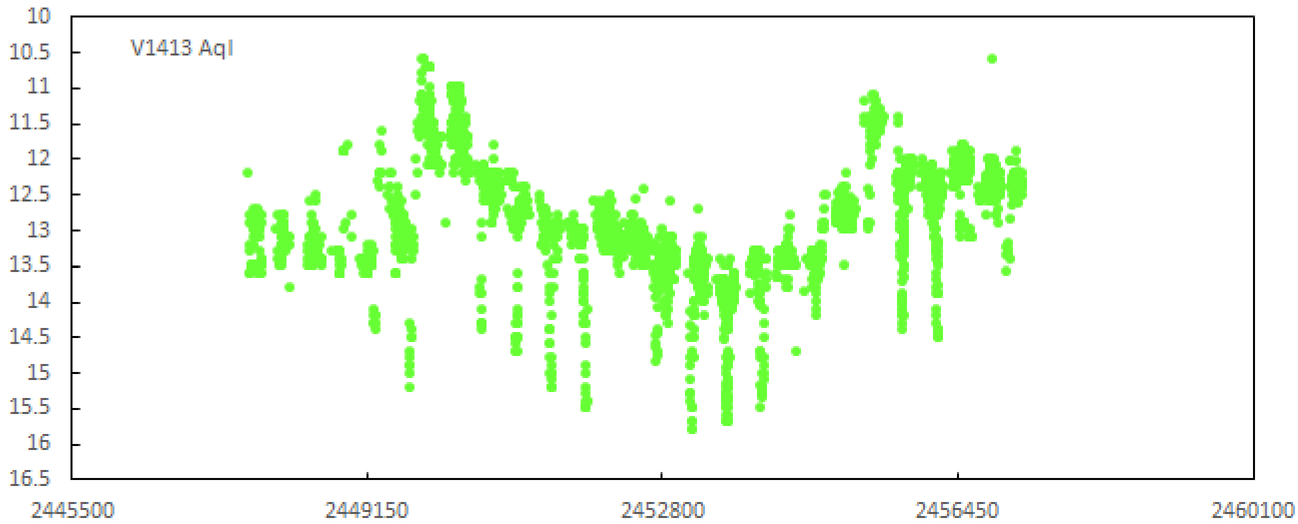




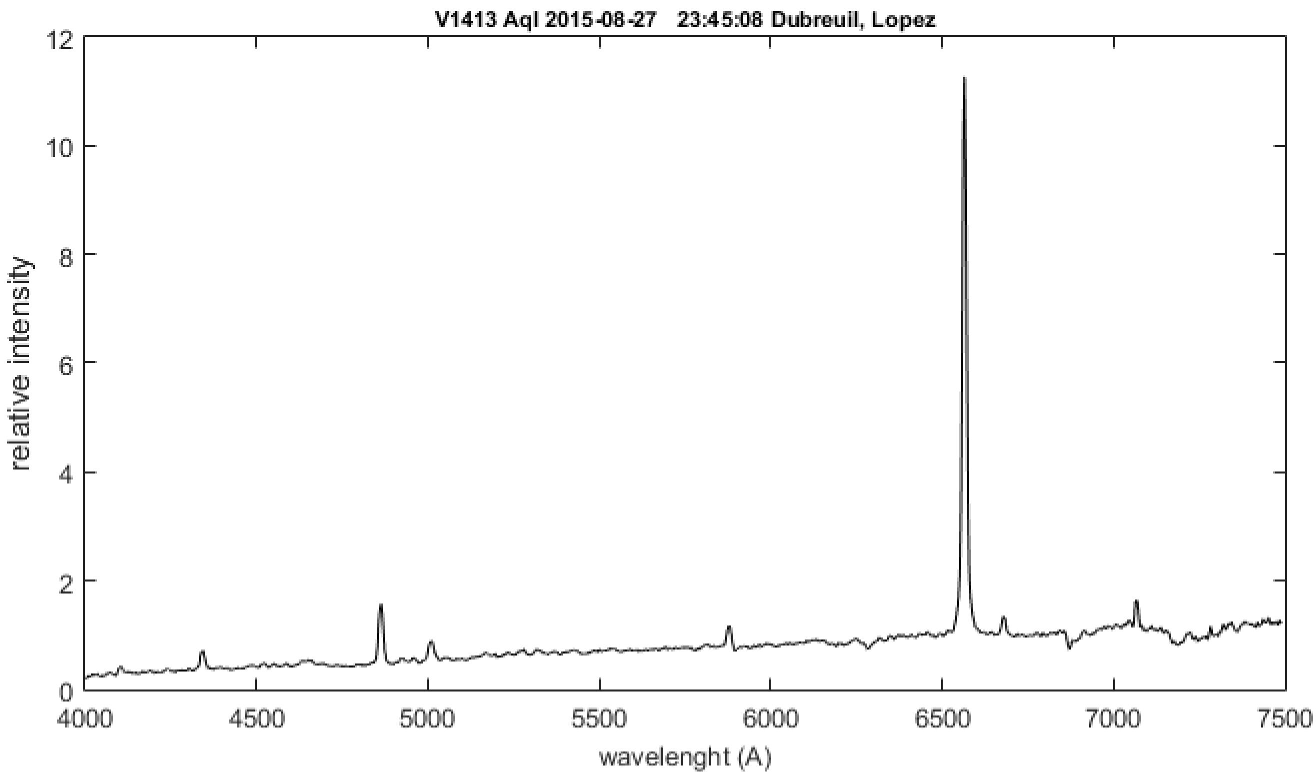


Crop on Olivier Garde's spectrum
Note the strong Raman OVI 6830, 7088

Coordinates (2000.0)	
R.A.	19 03 46.8
Dec.	+16 26 17
Mag V	10.5-15.5

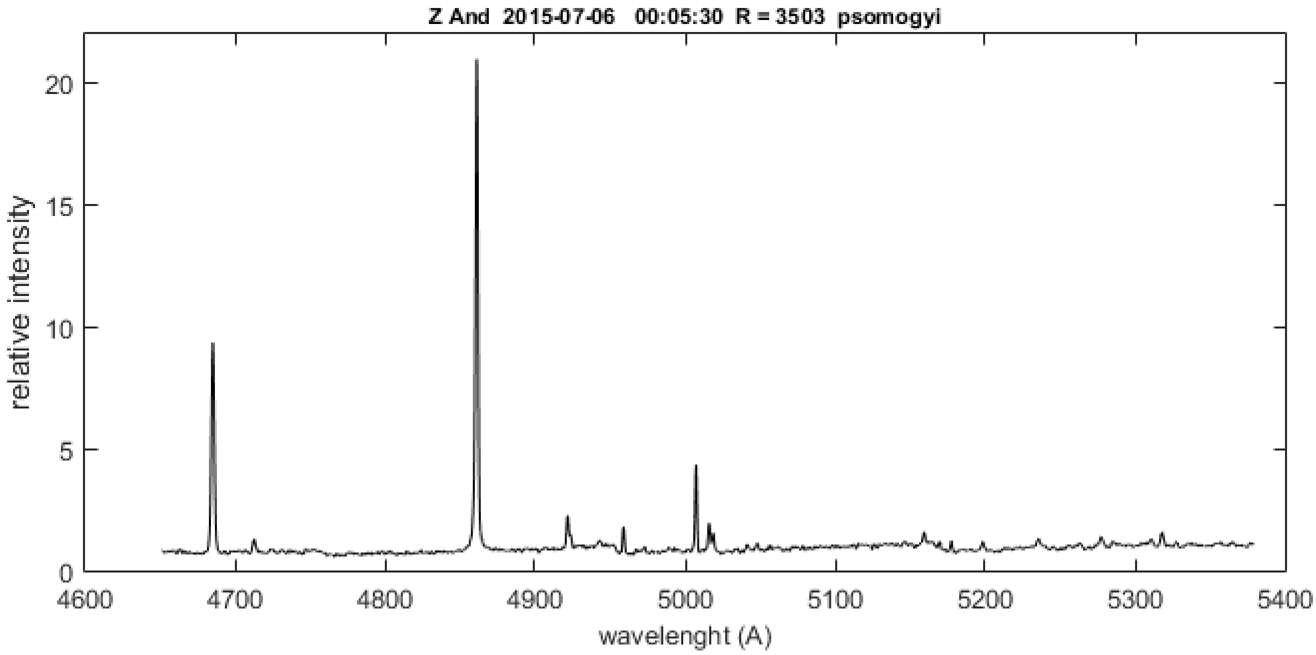


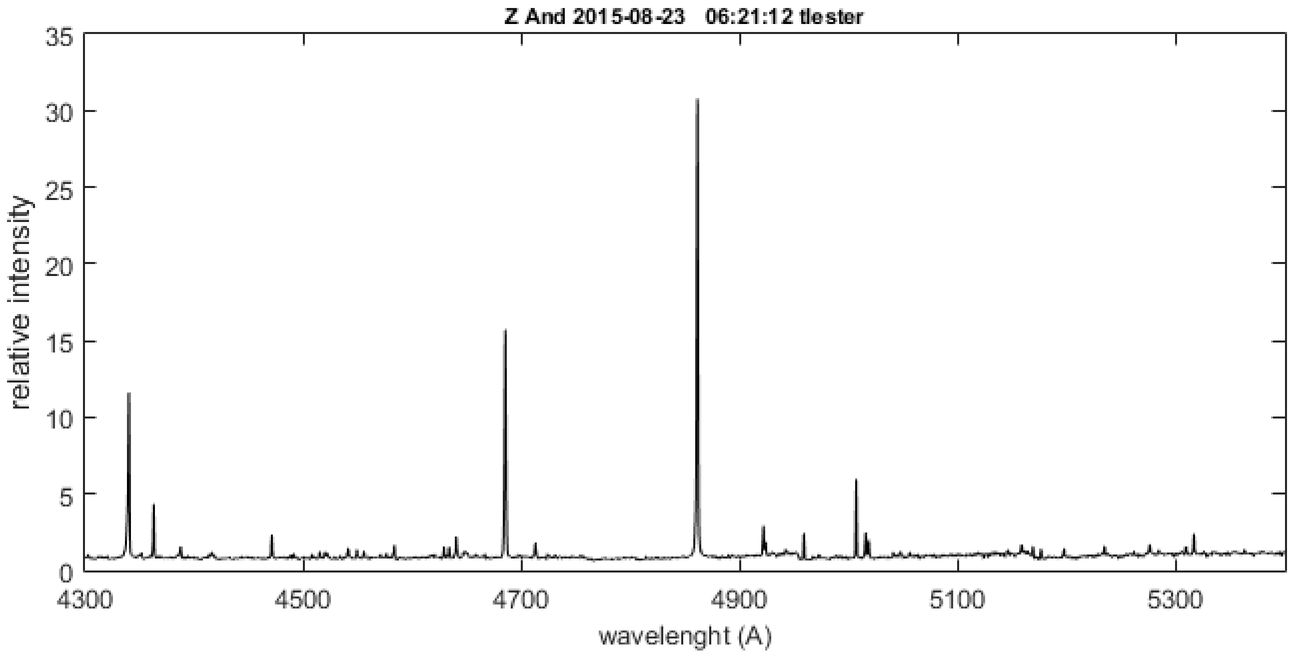
AAVSO Long term light curve (V + Vis.) Since 1989
The main tick is 10 years

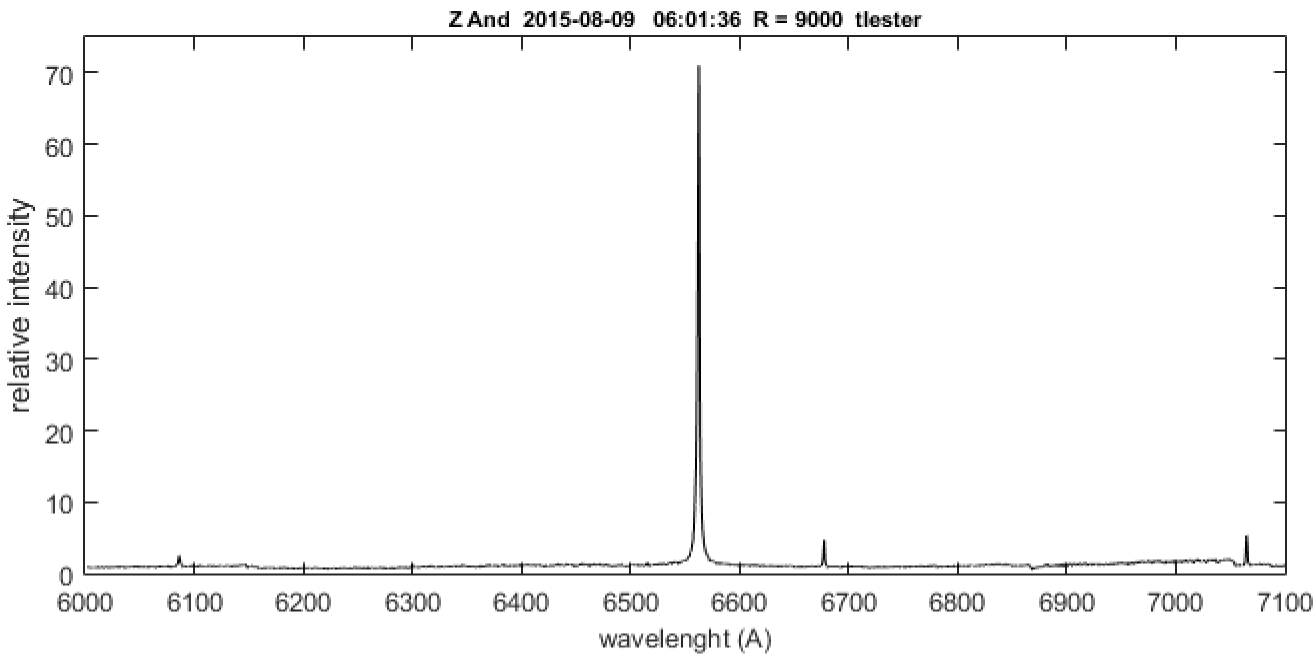


Z And

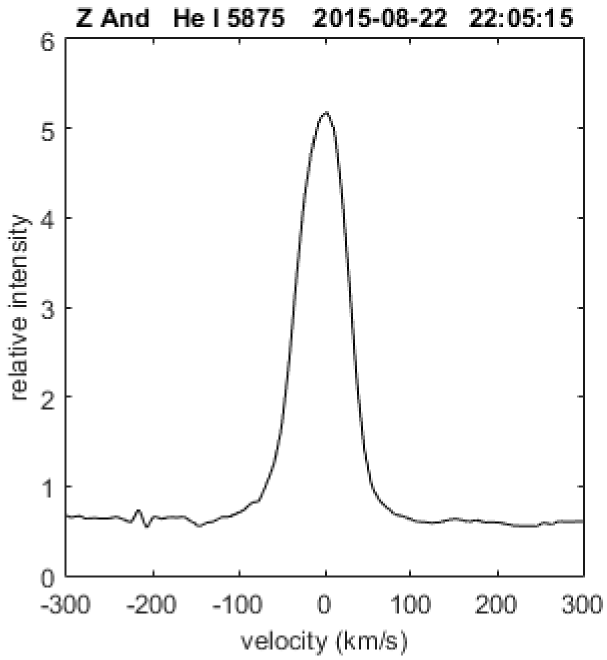
Coordinates (2000.0)	
R.A.	23 33 40
Dec.	48 49 06
Mag V	10.1

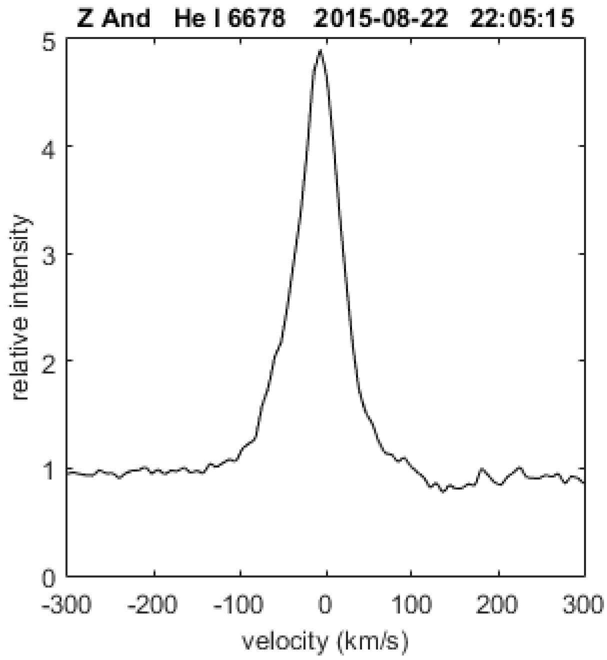


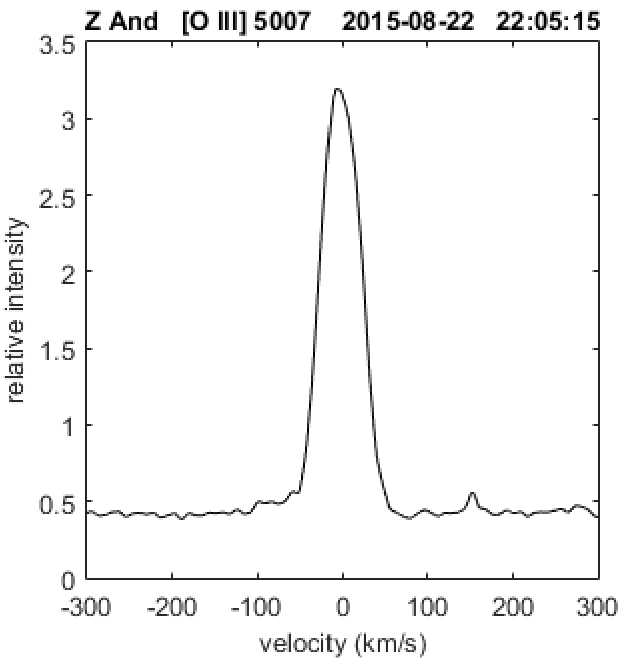

Z And 2015-08-23 06:21:12 tlester
relative intensity
wavelenght (A)

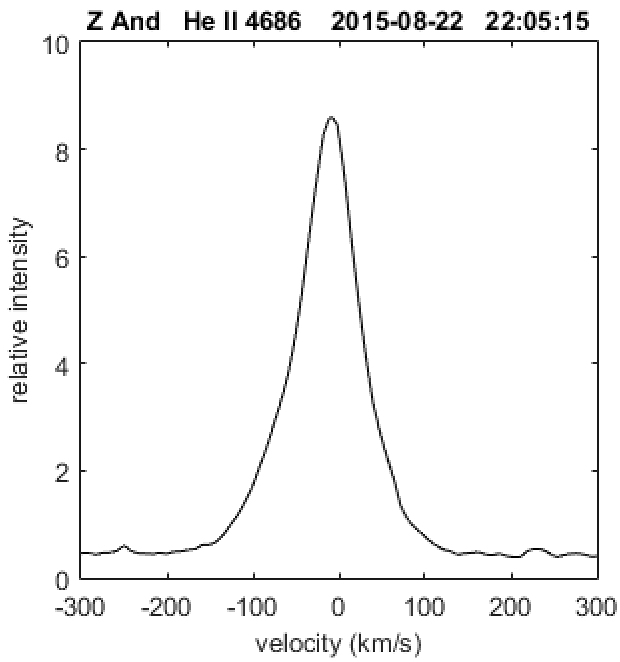

Z And 2015-08-09 06:01:36 R = 9000 tlester
relative intensity
wavelenght (A)

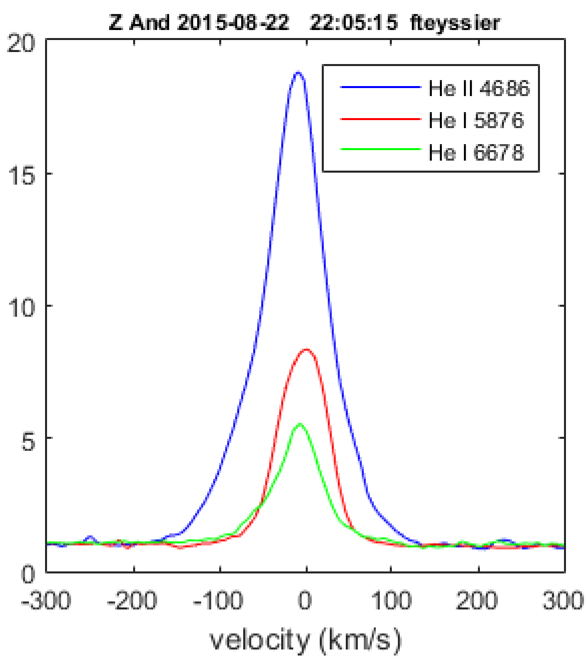
Z And with esHel spectrocope R = 11000

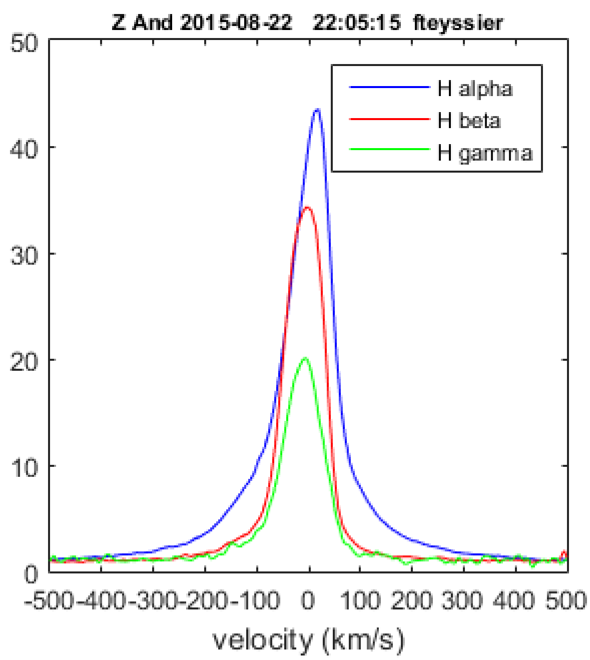


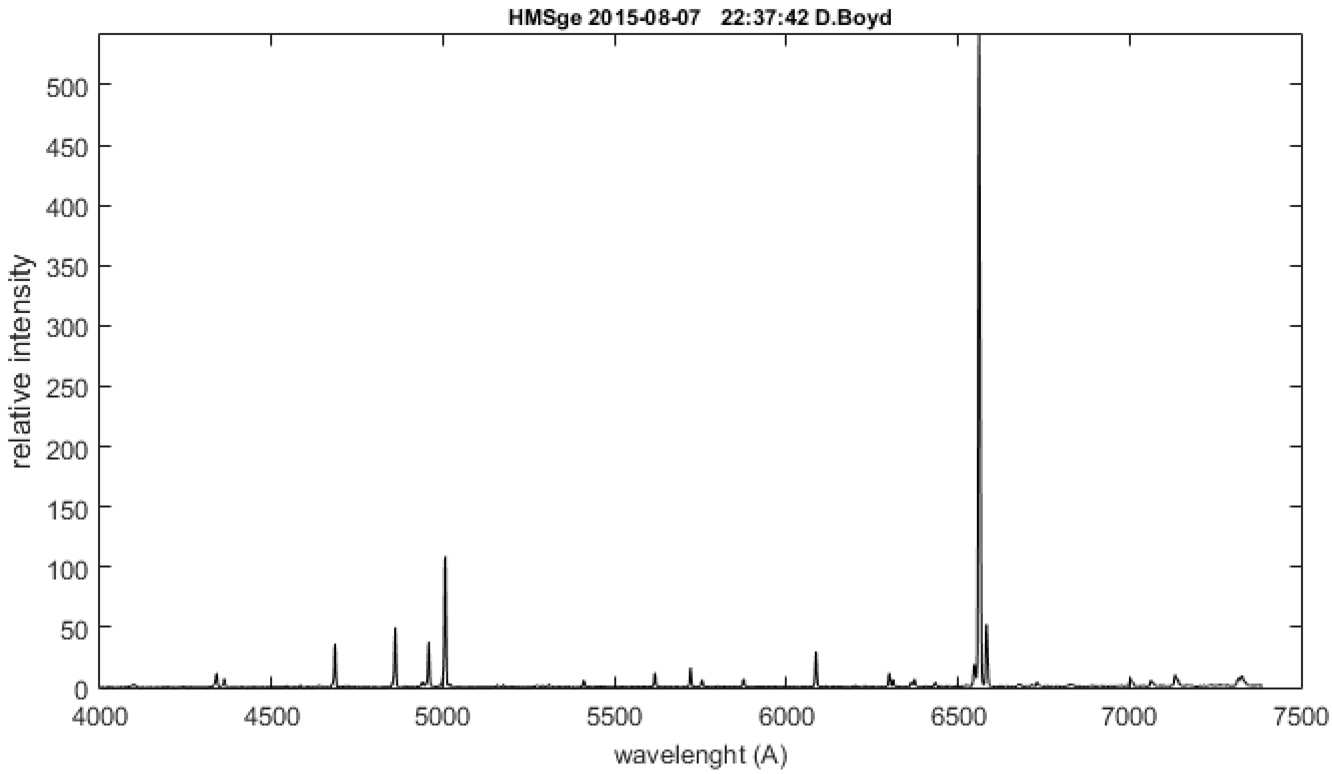


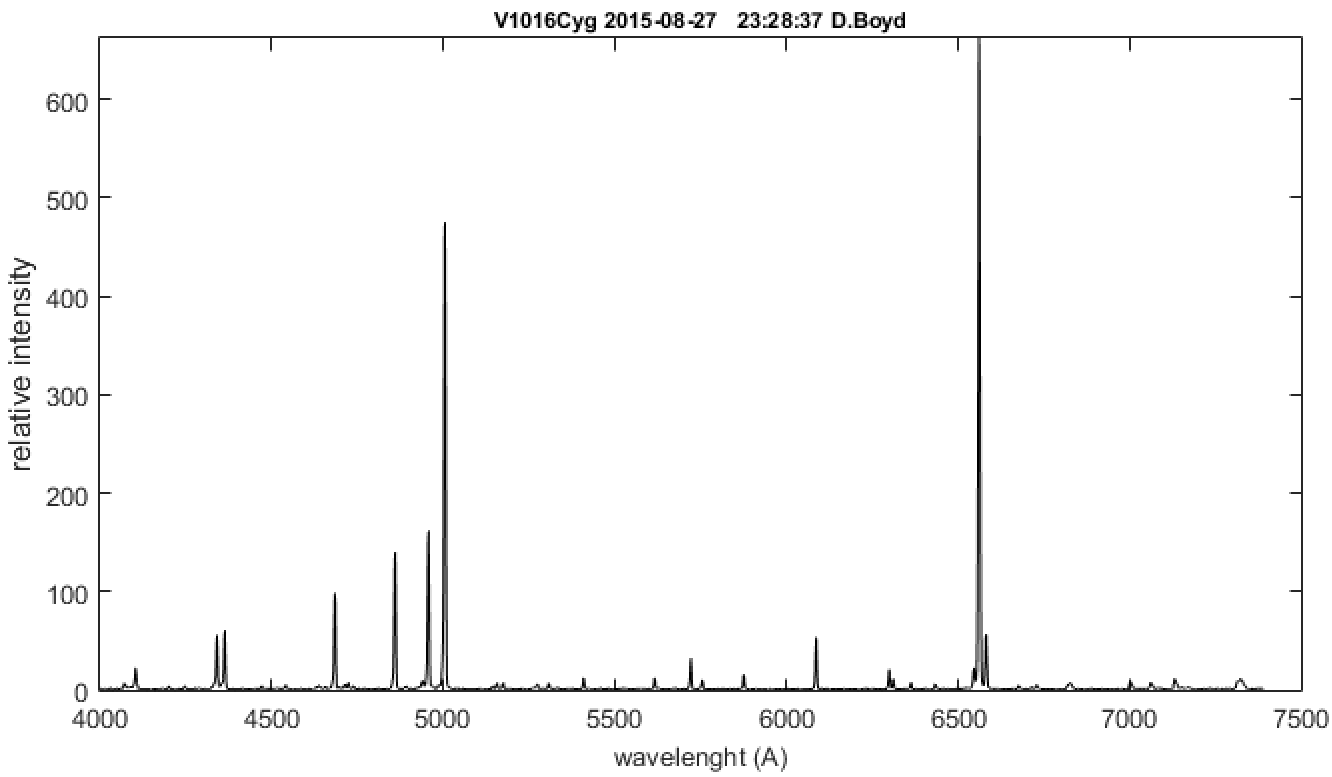




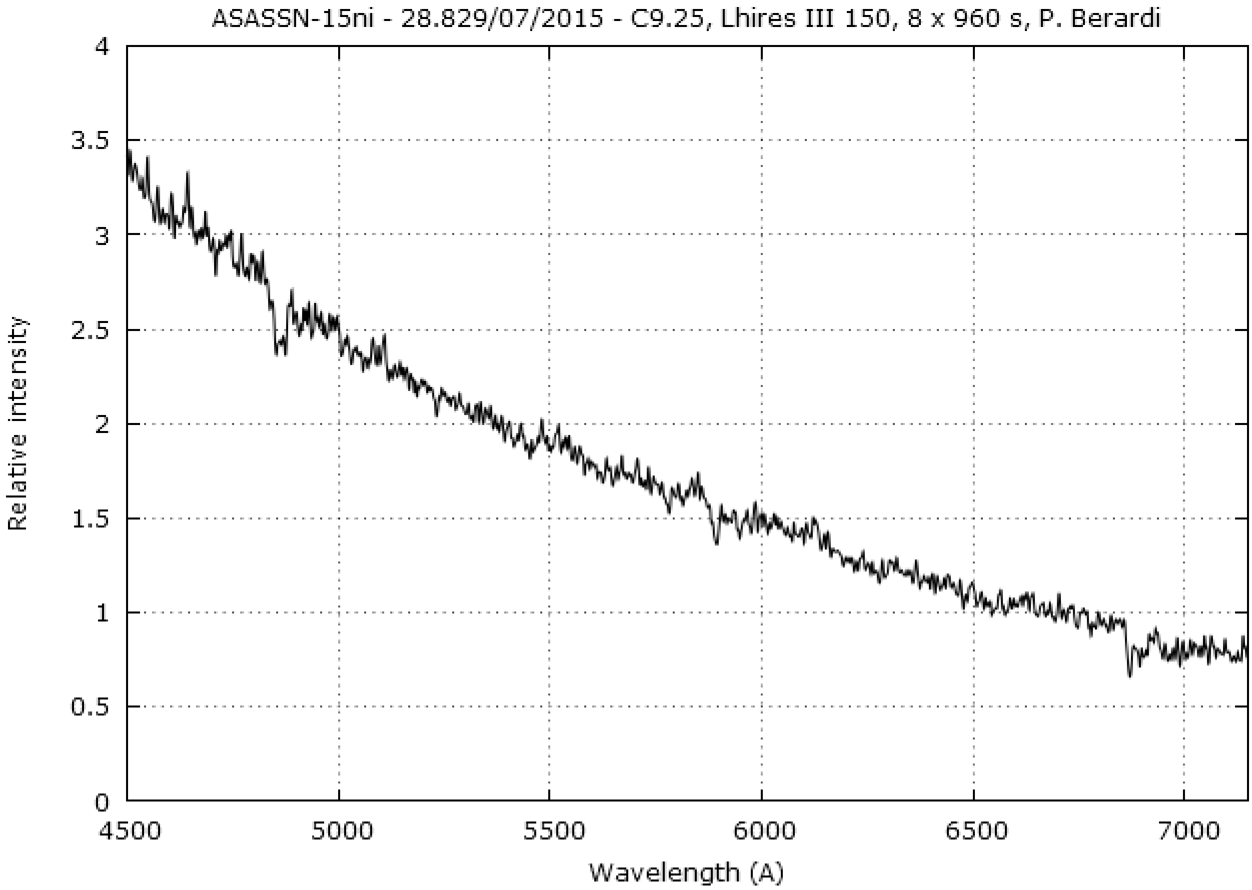





HMSge 2015-08-07 22:37:42 D.Boyd
relative intensity
wavelenght (A)
0
50
100
150
200
250
300
350
400
450
500
4000
4500
5000
5500
6000
6500
7000
7500


V1016Cyg 2015-08-27 23:28:37 D.Boyd
relative intensity
wavelenght (A)
0
100
200
300
400
500
600
4000
4500
5000
5500
6000
6500
7000
7500

Paolo Berardi identified the transcient ASASSN 15 ni as a cataclysmic star with a spectrum obtained the 28th of July



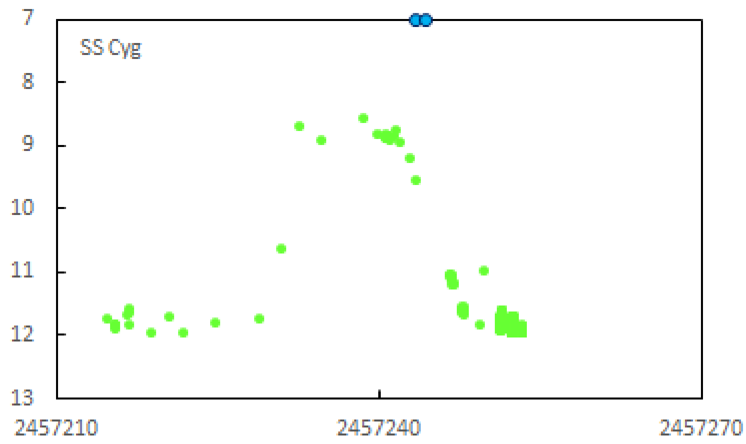
The Astronomer's Telegram

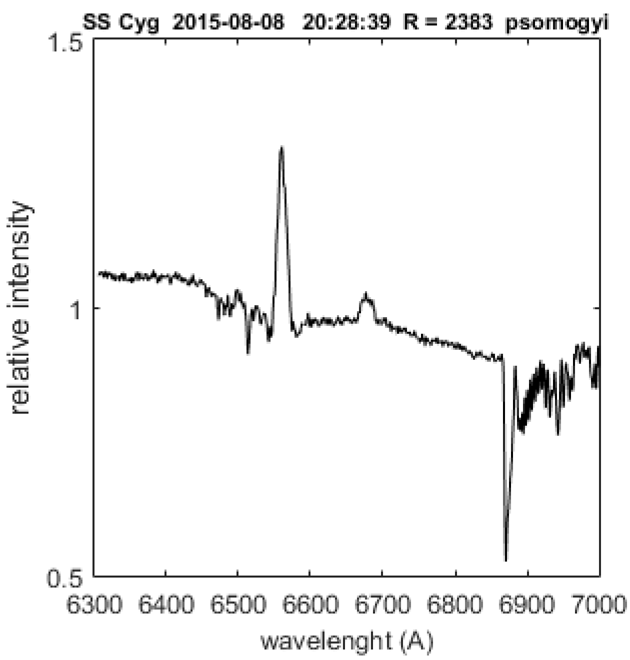
Spectroscopic classification of ASASSN-15ni as a cataclysmic variable in outburst

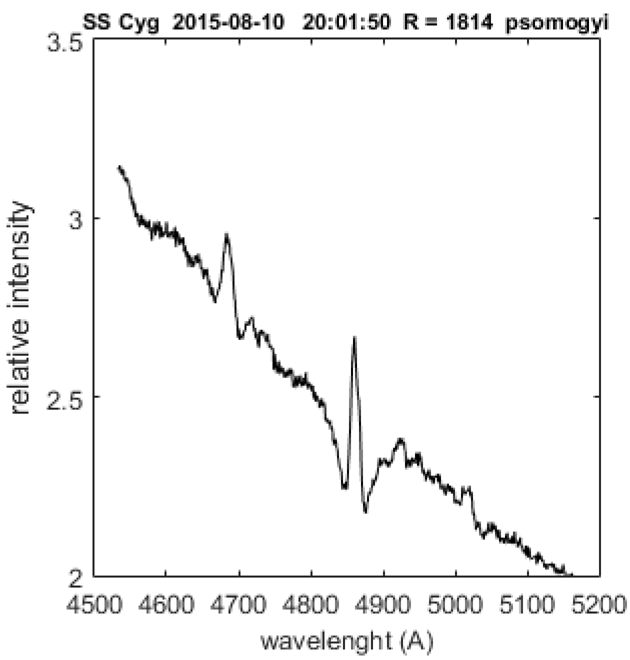
ATel #7854; Paolo Berardi (ARAS)
on 28 Jul 2015; 23:35 UT

We report a low-resolution optical spectrum of ASASSN-15ni (ATel #7850), obtained on 2015-07-28.929 using a 0.23-m Schmidt-Cassegrain telescope and a Lhires III spectrograph configured for low-resolution (450-715 nm, res. 1 nm). The strong blue continuum, a faint emission of H-alpha line, a narrow component in a broad absorption for H-beta line and CIII/NIII 4640 blend in emission suggest that the transient is a dwarf nova in outburst.

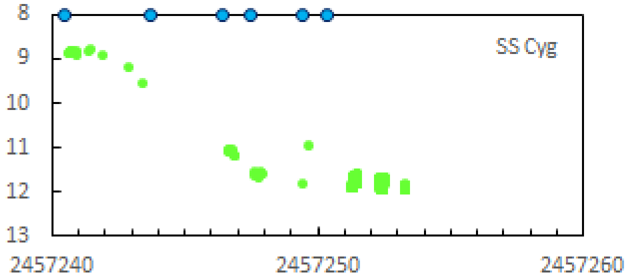
ASSASN program : Shappee et al. (2014) http://adsabs.harvard.edu/abs/2013arXiv1310.2241S
ASSASN transcients : http://www.astronomy.ohio-state.edu/~assassin/transients.html


SS Cyg
7
8
9
10
11
12
13
2457210
2457240
2457270

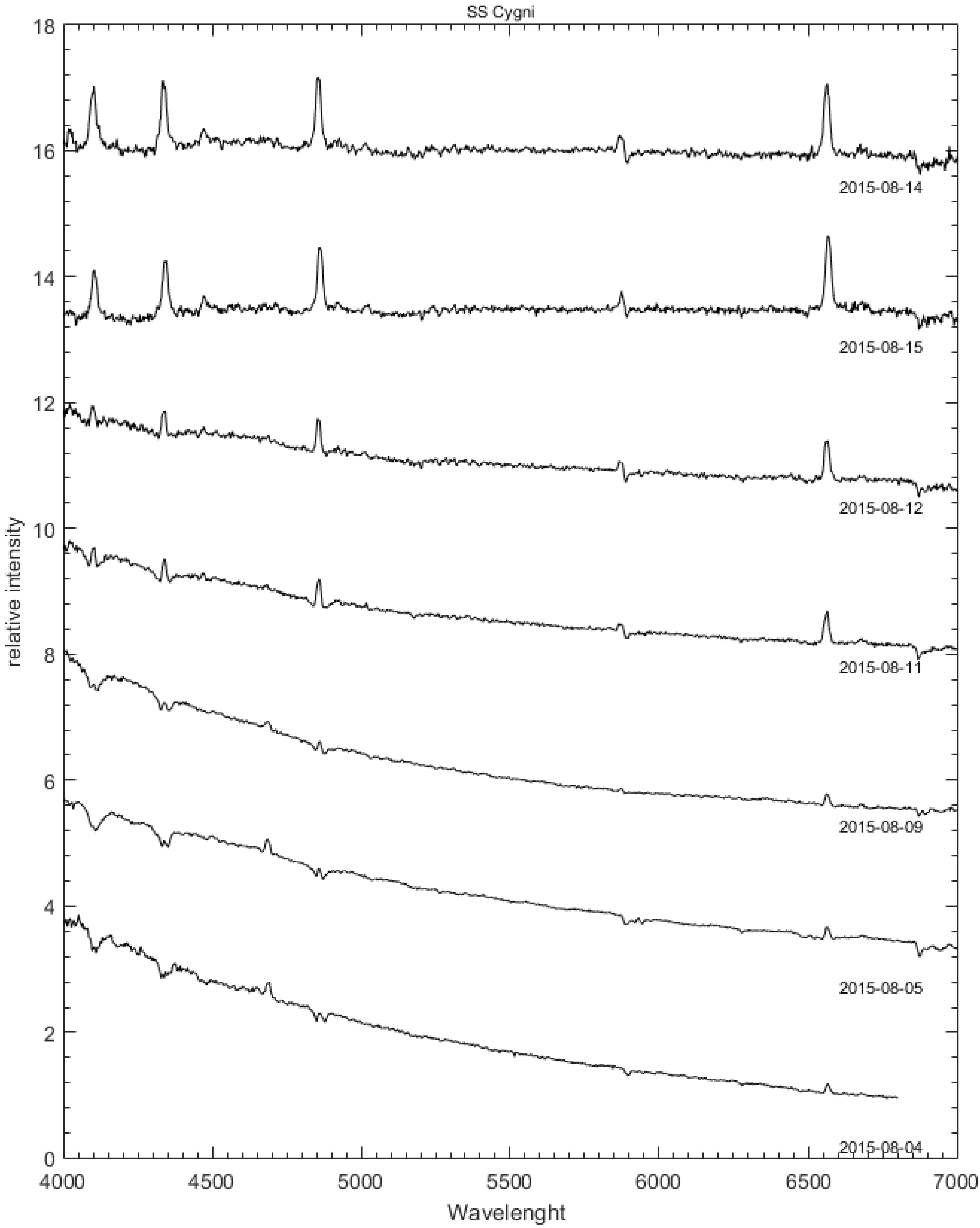

SS Cyg 2015-08-08 20:28:39 R = 2383 psomogyi
relative intensity
wavelenght (A)
1.5
1
0.5
6300 6400 6500 6600 6700 6800 6900 7000


SS Cyg 2015-08-10 20:01:50 R = 1814 psomogyi
relative intensity
wavelenght (A)
3.5
3
2.5
2
4500 4600 4700 4800 4900 5000 5100 5200

SS Cygni 2015 August Outburst

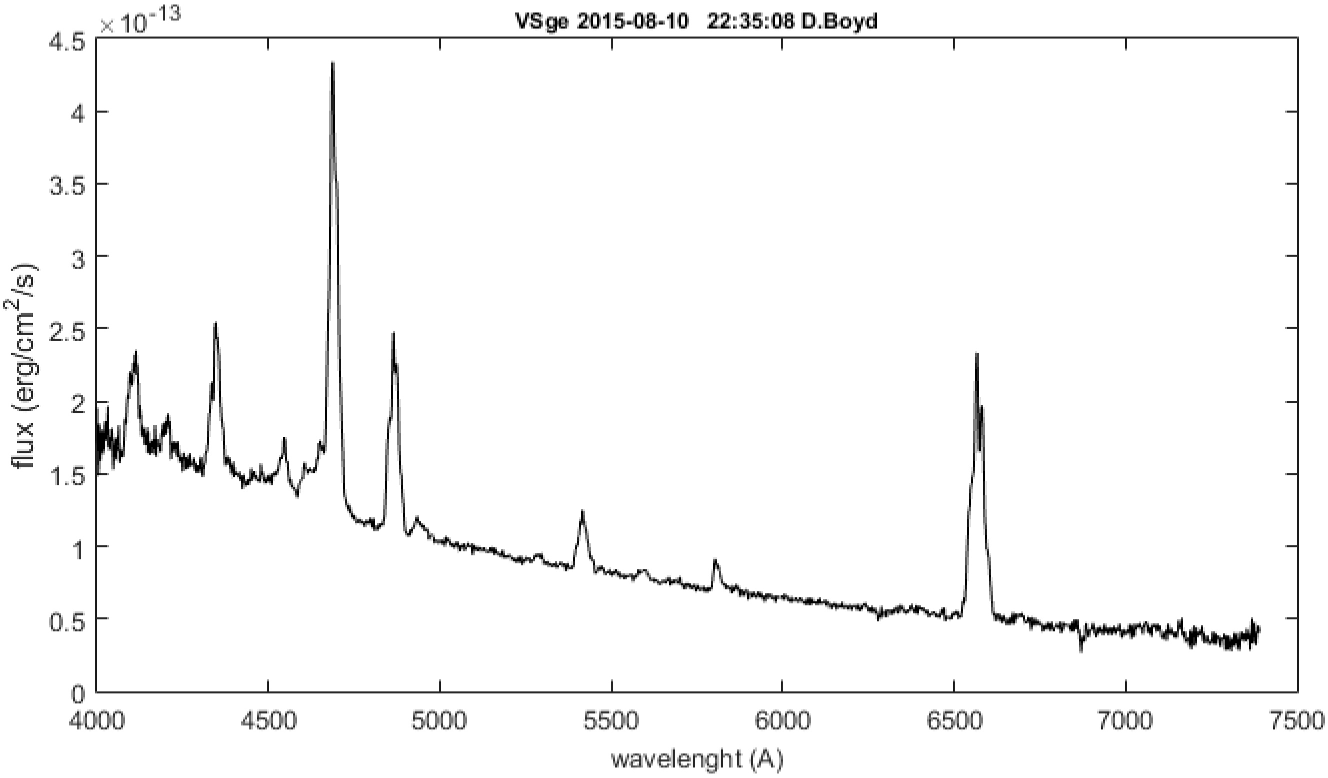


The spectroscopic evolution during the outburst with spectra of U. Sollecchia, K. Graham and V. Bouttard



V Sge

Coordinates (2000.0)	
R.A.	23 33 40
Dec.	48 49 06
Mag V	10.1



... and now more on line formation and stellar atmospheres: sunrise and sunset: Eclipsing systems as probes of atmospheric structure

Steve Shore

Dawn or sunset provides the best comparison with the z Aur stars. You see a change in the color of the Sun although you know perfectly well there isn't any intrinsic difference between the star at noon and near the horizon. The most obvious effect is reddening, the B-V changes systematically with altitude. The sky color also changes, but we'll come back to that in a moment. The main effect is from scattering, as we've discussed in earlier installments. Rayleigh scattering from molecules in the atmosphere, especially N_2, has a larger cross section for shorter wavelengths. Since this is a non resonant process, from the far wings of the transitions (and therefore far from the resonance frequency), it varies as $(\text{frequency})^4$, which means that across the visible band (from, say, 4000 to 8000 Å) this changes differentially by a factor of 16. When put in magnitude units, it means the color of the Sun changes by E(B-V) ~ 0.5, so the Sun goes from having the colors of a slightly later spectral type than its real G2V (because of the scattering even at minimal zenith distance) to looking like an late K star. This effect is removed automatically when you do photometry using standards in the same part of the sky as the target, and is nearly all removed spectrophotometrically with standards, but not quite. Small differences in angle of viewing when near the horizon become a problem because of the temperature gradient. The index of refraction is not constant, it varies with both temperature and wavelength density (it is also wavelength dependent) and the temperature is quite variable with altitude (hence, line of sight) such that a star can be seen below the horizon. This also depends strongly on wavelength so the images of the star actually separate. This is not easily seen for the Sun since it's so large relative to the angular dispersion of the image, but the effect is there.

This is a continuum process. Dust exacerbates the effect, usually being concentrated in the troposphere and, therefore, at the lowest angles relative to the horizon. You see this as a more extreme change in the color of the Sun. But unlike scattering, dust is also a continuum absorber and this also depends on wavelength. So the brightness of the star diminishes differentially, not simply with the altitude but perhaps even more rapidly near the horizon. Water vapor has a different effect, producing scattering at large angle (halos, rainbows - when backscattered - and glories), all of which include dispersion. The differences between ice and liquid water droplets is the cause of these different effects, ice doesn't rainbow scatter while water doesn't form distinct parahelia (like halos). The sky color changes because the scattered light from the Sun is now even more weighted to the red than before so the overall diffuse light changes its spectral distribution. This does not affect the line spectrum, although the atmosphere does produce a separate signature. The absorption bands you've tried so often to carefully avid or remove, those around 6700-7200A, the forest of water lines and innumerable O_2 transitions throughout the red part of the spectrum all come from the molecular constituents of the Earth's atmosphere. They don't increase linearly with angle, though. Not even according to the usual angle dependence that the optical depth at zenith is $\tau_{0} \neq 0$ while that at some zenith angle is $\tau = \tau_{0}/ \cos z$, the airmass being the ratio τ / τ_0. Any absorption is from permitted transitions, the optical depth of the atmosphere in the visible is quite low (for absorption, not for scattering) so the absorption alters some of the spectrum but other portions are free of contamination, for instance below 5000 Å. Finally, the ionization continuum of ozone in the Earth's (or planet's) atmosphere kicks in and dominates the opacity in the near UV. There are also dissociative transitions, and at progressively higher energies many overlapping ionization and dissociation continua for the different constituents change the spectrum of the incoming sunlight. We, of course, don't see these because the opacity of ozone is so high that the atmosphere is completely opaque below about 3000 (hence the justification for spectrographs such as GHRS and STIS on HST).

Now turn this around and think of a B star passing behind a late type supergiant or giant, as we see in the z Aur systems. For the moment, ignore any circumstellar matter. Just imagine a pure atmospheric eclipse. A B main sequence star is about a percent the radius of the giant, and therefore is very close to a point source as far as we, Earthbound observers, are concerned. Any eclipse is, therefore, a pencil beam through the giant outer atmosphere (until the optical depth along the line of sight is large). It is *precisely* the same as seeing a sunset from the ISS with all of the curvature effects of the atmosphere and all of its various depth dependent opacity sources. In the Earth's atmosphere, water is concentrated in the lower part, the troposphere, along with most aerosols. The molecular species extend through the ionosphere but there are several temperature inversions. These are the effect of the illumination from the outside, which we should now consider. But it's enough to say that what we've just discussed is precisely the same as observing an exoplanetary transit. The only difference, that feature that makes it harder to understand the details in the absorption spectrum of transits, is that the star is a uniform background screen against which the planet is seen. Not the other way around. So all of the scattering effects complicate things enormously. Think, for instance, of the ring of scattered light surrounding the Earth as seen from the Moon during a lunar eclipse. Or worse, the ring like appearance of Venus in inferior conjunction! You're seeing the whole atmosphere at once, with internal scattering and absorption along all lines of sight against a screen that is not uniform (and may be changing over time). It isn't just a signal to noise problem, the atmosphere is seen in transmission but it is strongly nonthermal in character because of the molecular scattering.

Now consider a stellar atmosphere. What we know about its structure is either obtained from the one spatially resolved star we can observe, the Sun, or from the reconstruction of density and pressure profiles in an inversion process from the angle integrated spectra. The observed spectrum is simpler than the planetary for a single reason: single stars pass flux only outward. The outer condition on the layers of the optically thin part of the star is that there is no *incoming* light. The temperature gradient may change its value (the tendency), and zones where the gas becomes particularly opaque across the entire spectrum may become buoyantly unstable and start to pass energy by gas motion - convection. But *globally the temperature gradient is monotonic*. The outer layers are progressively more optically thin and lose energy more easily, hence they cool. The photospheric spectrum then passes through a region that is *always* less emitting and, therefore, forms absorption lines against the surface. This does not mean the layer is much cooler, just that the excitation is lower and there is progressively lower continuum contribution (ignoring, for now, scattering).

The Sun shows, however, that this picture is much too simple for later type stars (F-M stars). These have outer convective layers, unlike stars above a few of solar masses where the hydrogen ionization zone is buried rather deep (above optical depths like 10 or 20). The surface opacity below about 8000K (at photospheric densities, about 10^{14}cm^{-3} or higher) is from an amazing ion, H^-. The ion, which is permitted because the 1s state of neural hydrogen can contain up to two electrons (the 1s state is the ground state and this can form a singlet $^1S_0$ as for He I). The difference is that there is still only one proton in the nucleus and partial screening reduces the ionization energy to about 0.7 eV. This happens to be right about the peak of the photospheric radiation so the opacity of the outer layers is very large, but not through the whole visible region (it's weighted to the IR). So the lower atmosphere and photosphere are convective. The acoustic oscillations - sound waves - generated by the surface and envelope mass motion propagate throughout the atmosphere. Those moving upward radiate and weaken, those kicking around in the envelope produce the oscillation spectrum used in helioseismology. While this may seem off the topic, it is important to recall that when you look through the Earth's atmosphere -watching a star - it twinkles and dances. The same will happen looking through a giant, only on much longer timescales and not as much. Even planets twinkle and shift in position shift he convective cells are large enough to produce a substantial change in the refractive index. This is the same in a giant, only on a longer timescale. The buoyant velocity, from Archimedes' principle if we need a name, depends on the surface gravity, g, and the lower g the slower the motions and less efficient the convection. The *scale height*, the distance over which an atmosphere's pressure or temperature changes by about 1/e, is also larger for lower g (less confined) and also for higher temperature T. The problem is that the outer atmosphere, above the temperature minimum of about 4000K, starts to steeply rise at the *chromosphere*, reaching around ten times the photospheric temperature within about 10^4km (about 1% of the solar radius). The rise continues into the corona , where the kinetic temperatures are measured by the ions present, such as Fe VII-XIV (forbidden lines in general since the densities are so low), He II, etc, that require temperatures of 10^6K or higher for collisional excitation and ionization. What signals that we have a chromosphere is the emission core in lines for which the photosphere shows absorption, e.g. Ca II K and K. Again, an increase in excitation (produces emission when viewed against a lower excitation zone and in the Sun this is collisional, hence from temperature, but it doesn't need to be). But this is because you see a layer that has a higher emissivity against a part of the surface (in a particular wavelength interval) within which the emissivity is lower. Not all lines show the effect, a real increase in kinetic temperature (and not just excitation) also changes the ionization state of the gas so some ions seen in the photosphere in absorption that would be possible emitters disappear. Some of the other spectroscopic effect you know from images of the Sun taken in different narrow bandpass filters. You've certainly seen that there are dark filaments seen projected against the lower chromosphere in some Ha images. In other cases, from Solar Dynamics Observatory (SDO) (that images the Sun in the FUV and soft XR) at times the He II 303 line appears in absorption. This is again an effect of relative emissivity.

But one comment on a related effect: transiting hot WDs: There are a few compact systems that show similar effects from absorption lines of higher ionization species. Examples are V471 Tau (= BD+16°516, a 30,000K WD plus subgiant K system with a 0.5 day period eclipsing orbit) and FF Aql (a G8 III + subdwarf O binary in an eclipsing 9.2 day orbit). Both systems have cool stars that are active, in FF Aqr chromospheric-like loops have been detected during transits, 3 and the UV shows effects of the chromospheres. These and related systems are important examples of possible feedback on the outer atmosphere but also constraints on the heating mechanisms responsible for producing the chromospheres and coronae in the first place. In the UV these show, for example, C IV and He II that come from the upper chromosphere above active regions and are not always there. Much of this work was done only when IUE was still operating, before 1997, but it would be very interesting to try this again with Ca II (although difficult because of the rapidity of the incress and egress times for the eclipse).

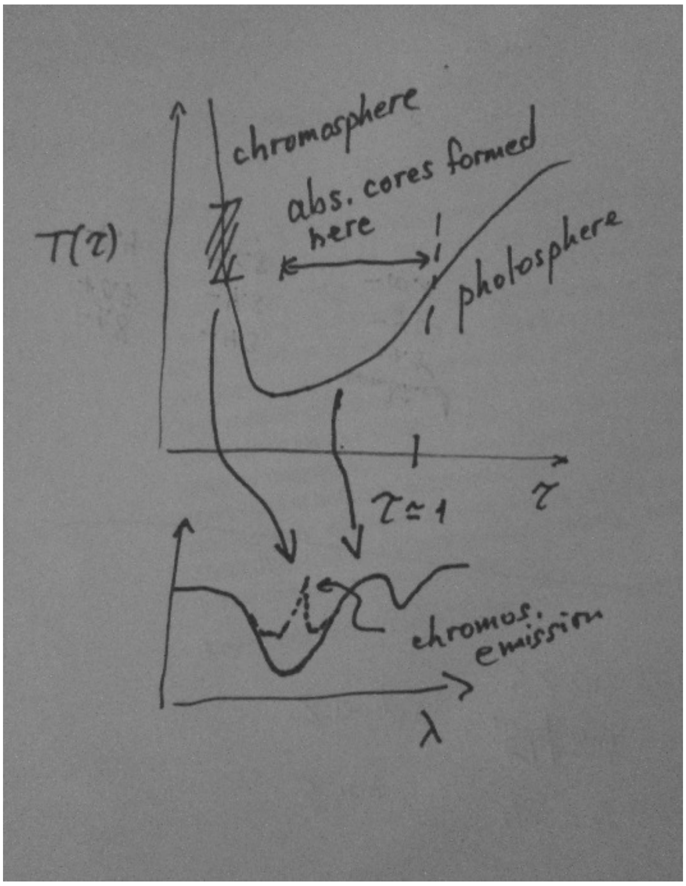
Now compare this to what happens in a system in which one star has a harder radiation field (or, less correctly said, has a higher effective temperature) than it companion and is close enough that the input flux *from outside* is competitive with that emerging from the photosphere. In a planetary atmosphere, the upper layers are ionized by input chromospheric and coronal UV and XR emission. There is virtually no emission from the planet itself, let alone at that wavelength. This is independent of any charged particle-induced ionization (e.g. cosmic rays, solar wind). The extra heating produces hot electrons so the

Eclipsing systems as probes of atmospheric structure

Steve Shore

collision rate increases and you see emission from ionized forbidden transitions, e.g. [O III]. You also see [N II] and [O I], all of which are ground state lines that emit in the optical and are easily excited by collisions at about 1 eV. But this is the key. The normal temperature of the atmosphere is about 300K (about 0.03 eV). The upper atmosphere shows lines excited by collisions at around 1 eV and this extra energy is from ionization and free electrons heated in the process. You won't see this in the z Aur systems, or very little, depending on the temperature of the disk if one is present.

The A or B star in the ζ Aur systems, e.g. τ Per, 31 Cyg or 32 Cyg, have strong UV continua. These are, however, not hot enough to substantially ionize the atmosphere of the supergiant so this is a *far less extreme example of the wind effects in the symbiotics*. Recall that in those systems, the accretion onto the white dwarf companion from the giant's wind powers an emission extending to the X-rays. For these systems, that have not too different orbital properties than the symbiotics, the companion is a much lower surface gravity object (even if it has a higher mass, the surface gravity is 4 orders of magnitude lower than a white dwarf) so accretion can produce a disk that emits in the infrared but not in the harder spectrum. It produces reflection, but not ionization feedback, and therefore is not going to have as significant an impact on the outer atmosphere as the Sun has on a planet. There is no ionospheric-like layer and almost no radiative induced temperature inversion. In closer X-ray binaries, or in cataclysmic-like hot WD star systems (for instance V471 Tau) the input at the top of the companion's atmosphere from the UV is significant and changes the temperature structure (producing, for instance, temperature inversions). For the z Aur systems, the eclipse is much closer to that we discussed at the start. The probe is passive. It gives the density (through the column density) and temperature (through the relative optical depth of absorption lines as a function of the energy of their lower level). While this seems less exciting, perhaps, than the violence and unpredictability of cataclysmic systems, keep one important thing in mind: it these wide binaries are the only chance we have to understand the atmosphere of giants, to see the base structure and probe the turbulent motions, to see time dependent hydrodynamic effects. These stars are sources of mass return to the interstellar medium and the chemical evolution of the galaxy. They are evolved, massive stars unlike the symbiotics. They connect to the B[e] and Luminous Blue Variables and are a chance to compare what we see in the eclipsing symbiotic systems such as EG And for the late 4 type giants and the supergiants. In short, while the phenomena may not be spectacular the physics is. We do not know if there i one or several mechanisms responsible for the heating of the solar - or cool star - outer atmosphere. Certainly it is connected with a surface convection zone and must be connected with the magnetic field. The solar wind is too dynamically responsive to changes in the global field during the sunspot cycle of the dynamo to imagine the two are unrelated. Also, certainly, the outer atmosphere is not an effective coolant in that collisions are progressively rarer with increased altitude so you don't get the electrons kinetically cooling. I know this seems contradictory to saying that an optically thin medium radiates effectively and is cooler *but that is for a medium that is both collisionally dominated and in which temperature of the radiation is the same as the kinetic temperature of the electrons*. In the solar wind, and the corona, this isn't true. Collisions are rare enough that ionization-liberated electrons, if they are also heated and accelerated, produce an outflow (the solar wind). Magnetic fields in the coronal zones are heating agents, e.g. reconnecting turbulence-driven twisted magnetic filaments and arcs releases stored energy of the field and emits energized waves that can accelerate particles without collisions). The low densities and high ionization and temperatures actually become thermally unstable and a hot region forms that can't efficiently cool. This leaves the chromosphere requiring heating from within and below while the corona can remain hot if once put in the right thermal condition.



Formation of chromospheric emission in the broad absorption by Thomas B. Ake (Editor), Elizabeth Griffin (Editor)

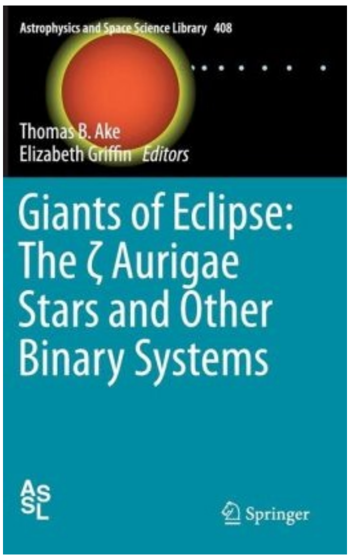
All this is probed by looking at the temperature and density structure of the chromosphere and any transient structures during eclipse. Again, to close this discussion, *remember that the solar corona was discovered during eclipses, when the photosphere is invisible, and that the look and streamer structures were first seen in projection against the disk in early interference mages with spectroheliographs and later seen in the extended structures of the corona*. We started with eclipses ad a technique for probing stellar structure. These pencil beam observations, similar to planetary occultation of stars, are the best probes we have of the outer atmospheres of the stars. A last point. The disk in VV Cep has been the focus of a lot of discussion. The same for emission regions like the presumed bow shock in these accreting cases. The disks here are not the same as the Be stars, or cataclysmics, and are transient and less stable. They are formed from a far less organized flow than through a Roche surface, and through their instability we learn about the turbulence, viscosity, and mass transfer in ways a less transient phenomenon won't reveal.

Thanks very much for your enthusiasm, participation, questions, and comments at Haute-Provence this summer. I sincerely hope you have a very good year, clear skies and tranquility in your lives, and that we'll see each other again soon..

Steve Shore
29-08-2015

List of Zeta Aur stars (from "Giants of Eclipse")

Star	GCVS	Spectral Type		V mag	Orb. Period [days]	Eclipse Duration [days]	Eclipse ΔV
Zet Aur		K4Ib	B5V	3.8	972	37	0.15
31 Cyg	V695 Cyg	K4Ib	B3-4	3.8	3784	61	0.1
32 Cyg	V1488 Cyg	K5Ib	B6V	4.0	1148		0.05
VV Cep		M2Iab	B0-2	4.9	7430	233	0.05:
22 Vul	QS Vul	G7Ib-II	B8.5V	5.2	249	8	0.05
HR 6902	V2291 Oph	G9IIb	B8.5IV	5.7	385.00	3.8	0.19
HR 2554	V415 Car	G7II	A1V	4.4	195.3		0.06
Tau Per		G8III	A4V	4.0	1516		0.16
Gam Per		G8II-III	A1 IV	2.9	5328	7.3	0.28
HD 223971	V413 And	G7III	F2IIIm	6.6	50.1	< 1	0.41

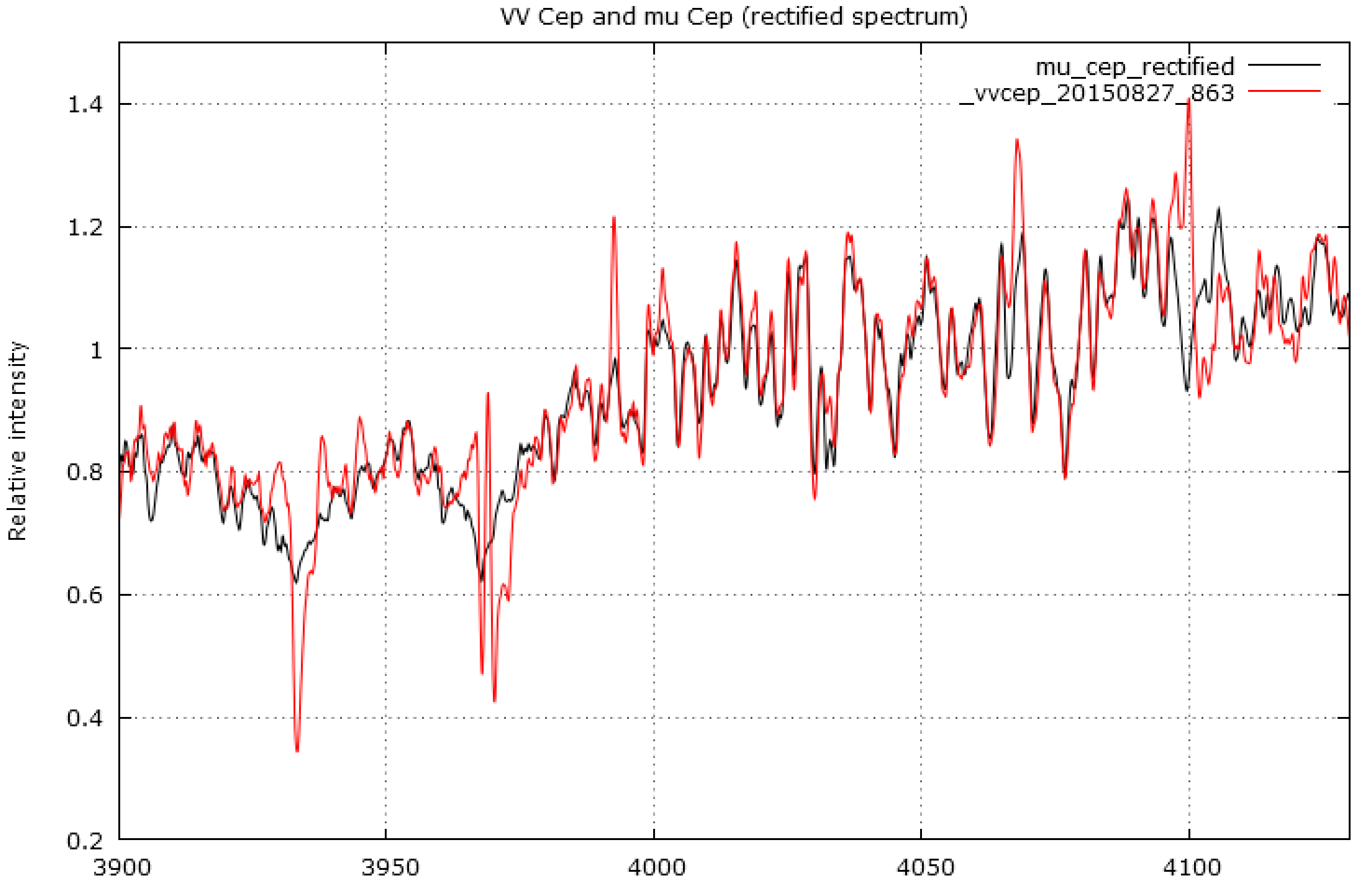


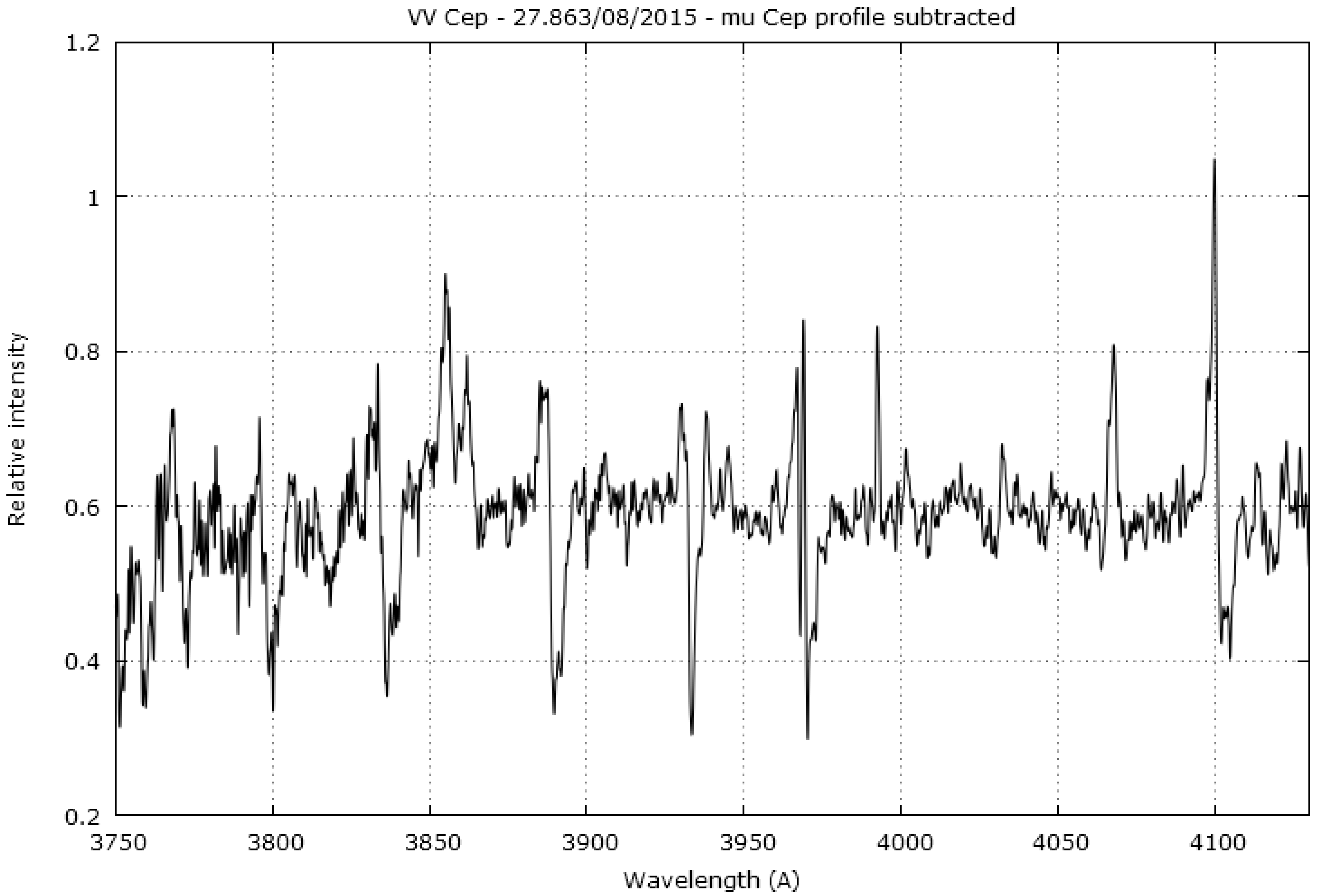
by Thomas B. Ake & lizabeth Griffin
pringer, 2015

ARAS Data Base (asdb) for VV Cep stars :
http://www.astrosurf.com/aras/Aras_DataBase/VVCepStars/VVCep.htm

VV Cep in near UV by Paolo Berardi

See : http://www.spectro-aras.com/forum/viewtopic.php?f=19&t=1233





OHP spectroscopy workshop 2015

OHP 2015 - Credit photo : Jim Edlin

From august 13th to august 18th took place he 11th annual spectroscopy workshop at Observatory of Haute Provence. More than 50 people – from France, Germany, Austria, USA, UK & Australia – gathered for this unique and largest spectroscopy workshop in the World.

With around 20 telescopes all equiped with several spectrographs in the field, it is certainly the biggest spectroscopy star party of the World. The main goal of this workshop is to practice astronomical spectroscopy and observe some given targets – this year focus was on AG Peg symbiotic star, VV Cep eclipsing binary with a 20.4 years period and next eclipse in 2017-2019, and Cat's Eye planetary nebula. On the last day, several spectra obtained during the workshop were compared and the level of quality reached was outstanding.

For the second year, François Cochard gave a daily morning training on astronomical spectroscopy for beginners. First session talked about optics & spectrogrphs. Second session was about spectra acquisition. Third session reviwed data reduction with a live demo with ISIS. Last session gave some best practices to improve quality of the spectra.

After the lunch (buffet), a short special event was organized every day including a visit at the 1.93m telescope on the site which discovered the first exoplanet 51 Peg-b, a talk by David Boyd about his observation of EE Cep (published in JBAA : http://arxiv.org/abs/1412.5127v1), another one by Ernst Pollmann followed by a great discussion on VV Cep and how to start observing before the coming eclipse (Cf SAS symposium paper : http://adsabs.harvard.edu/abs/2015SASS...34...83H), and a review of the LISA spectrograph radial velocities possibilites for spectrosopic binaries by David Boyd.

We also had an astrophysics course by Steve Shore, a professional astronomer from Pisa university, on accretion disks and binaries, with focus on novae, symbiotic stars such as AG Peg, VV Cep type of stars…

Couple of talks were given in the evening before the observations by François Teyssier on the novae and spectroscopy of the planetary nebulae.

All training, talks and courses were recorded (most of them were translated* either from french to english or english to french) and are available on-line at : http://www.shelyak.com/contenu.php?id_contenu=117&id_dossier=7&lang=2

Olivier Thizy
27-08-2015

** many thanks to Olivier Thizy for the translations (ndlr)*

Recent publications

Novae

Getting to know Classical Novae with Swift
Julian P. Osborne
http://arxiv.org/ftp/arxiv/papers/1507/1507.02153.pdf

Infrared studies of Nova Scorpii 2014: an outburst in a symbiotic system sans an accompanying blast wave
Vishal Joshi, D. P. K. Banerjee, N M Ashok, V Venkataraman, F.M. Walter
http://arxiv.org/pdf/1507.02487.pdf

Spectroscopic Study of the Envelope of the Hybrid Nova V458 Vul and Surrounding Nebula
T. N. Tarasova
http://arxiv.org/pdf/1508.03990v1.pdf

Symbiotics

WZ Sge-Type Dwarf Novae
Taichi Kato
http://arxiv.org/pdf/1507.07659v1.pdf

Periods in a 87 Years Light Curve of the Symbiotic Star MWC 560
Elia M. Leibowitz, Liliana Formiggini
http://arxiv.org/abs/1506.05584

Symbiotic stars in X-rays III: long term variability
N. E. Nuñez, T. Nelson, K. Mukai, J. L. Sokoloski, G. J. M. Luna
http://arxiv.org/abs/1505.00633

Accretion Flow and Disparate Profiles of Raman Scattered O VI λλ1032, 1038 in the Symbiotic Star V1016 Cygni
Heo, Jeong-Eun; Lee, Hee-Won
Journal of the Korean Astronomical Society, vol. 48, no. 2, pp. 105-112
http://jkas.kas.org/journals/2015v48n2/v48n2p105_hwlee.pdf

The first symbiotic stars from the LAMOST survey
Jiao Li, Joanna Mikołajewska, Xue-Fei Chen, A-Li Luo, Alberto Rebassa-Mansergas, Yonghui Hou, Yuefei Wang, Yue Wu, Ming Yang, Yong Zhang, Zhan-Wen Han
http://arxiv.org/abs/1505.06569

An ongoing active phase for the old symbiotic nova AG Peg

ATel #5258; U. Munari (INAF Padova), P. Valisa, S. Dallaporta, G. Cherini, G. L. Righetti, F. Castellani (ANS Collaboration) on 8 Aug 2013; 15:08 UT

he symbiotic nova AG Peg was shining at ~9 mag when in 1850 started the outburst that in 1871 reached a peak brightness of ~6 mag. The very slow rise to maximum was followed by an even slower decline that took longer than a century to complete. The star was at m(vis)=7.6 in 1943, at m(vis)=8.1 in 1963, m(vis)=8.5 in 1983, and declined to m(vis)=8.75 by 2003. We have closely monitored AG Peg over the last decade, observing how photometric and spectroscopic behavior was dominated by the ~827 day orbital periodicity. In particular, the brightness in the B band has followed the sinusoidal pattern expected from reflection effect (of the hard radiation from the WD illuminating the facing side of the non-variable M giant companion), from B~9.80 at maximum to B~10.25 at minimum. During the last weeks AG Peg has unexpectedly risen in brightness, about 0.3 mag above the brightness typical for that orbital phase. From B=9.79 on 2013 May 18, it continued to steadily rise to B=9.70 on June 18, and B=9.60 on July 18, peaking to B=9.570 on Aug 1, where it has remained ever since. Our last measurement reads U=8.95, B=9.577, V=8.430, Rc=7.314 and Ic=6.390 on 2013 Aug 07.986 UT. The unexpected rise in brightness is obvious at all bands. We obtained a fluxed low resolution spectrum on Aug 1 with the Asiago 1.22m telescope and B&C spectrograph (range 3230-7985 Ang, 2.31 Ang/pix) and high resolution Echelle spectrum with the Varese 0.61 cm (resolving power 17,000, range 3950-8630 Ang). Compared with equivalent spectra obtained at the same orbital phase during the previous orbital cycle, the most obvious change is the greater veiling at bluer wavelengths by a now much brighter nebular continuum, effectively overwhelming the M giant absorption spectrum shortward of 5500 Ang. The profiles of emission lines remain very sharp, with FWHM values of 42 km/s for HeI singlet and FeII lines, and 62 km/s for HeI triplet and HeII lines, and ~105 km/s for Balmer lines which shows a complex structure, values which are all about 15% smaller than typical for the current orbital phase. No P-Cyg absorption component is present at a preliminary inspection.

About ARAS initiative

Astronomical Ring for Access to Spectroscopy (ARAS) is an informal group of volunteers who aim to promote cooperation between professional and amateur astronomers in the field of spectroscopy.

To this end, ARAS has prepared the following roadmap:

• Identify centers of interest for spectroscopic observation which could lead to useful, effective and motivating cooperation between professional and amateur astronomers.
• Help develop the tools required to transform this cooperation into action (i.e. by publishing spectrograph building plans, organizing group purchasing to reduce costs, developing and validating observation protocols, managing a data base, identifying available resources in professional observatories (hardware, observation time), etc.
•Develop an awareness and education policy for amateur astronomers through training sessions, the organization of pro/am seminars, by publishing documents (web pages), managing a forum, etc.
• Encourage observers to use the spectrographs available in mission observatories and promote collaboration between experts, particularly variable star experts.
• Create a global observation network.

By decoding what light says to us, spectroscopy is the most productive field in astronomy. It is now entering the amateur world, enabling amateurs to open the doors of astrophysics. Why not join us and be one of the pioneers!

Be Newsletter

Previous issues :

http://www.astrosurf.com/aras/surveys/beactu/index.htm

Submit your spectra

Please :
- respect the procedure
- check your spectra BEFORE sending them

Resolution should be at least R = 500
For new transcients, supernovae and poorly observed objects, SA spectra at R = 100 are welcomed

1/ reduce your data into BeSS file format
2/ name your file with: _novadel2013_yyyymmdd_hhh_Observer
novadel2013: name of the nova, fixed for this object

Exemple: _chcyg_20130802_886_toto.fit

3/ send you spectra to
Novae, Symbiotics : François Teyssier
Supernovae : Christian Buil
to be included in the ARAS database

Download previous issues :

http://www.astrosurf.com/aras/novae/InformationLetter/InformationLetter.html

Further information :
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